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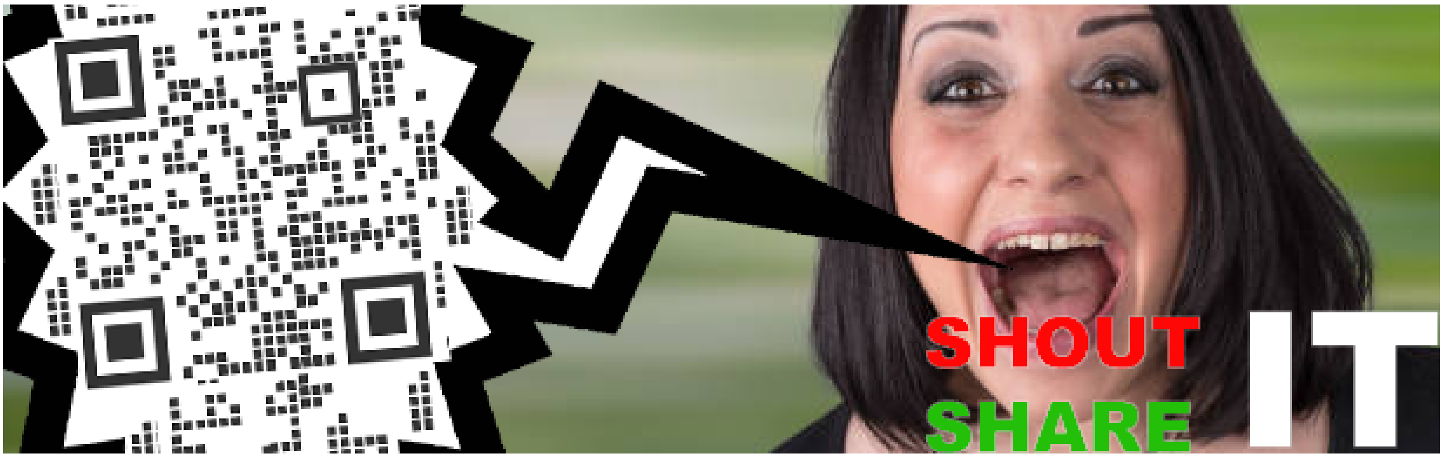
Forest monitoring good practices: inclusive smallholder data governance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Forest monitoring good practices: inclusive smallholder data governance

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Abbreviations

AgTech	agricultural technology
API	application programming interface
CARE	Collective Benefit, Authority to Control, Responsibility, Ethics
CSR	corporate social responsibility
DCF	Deforestation and Conversion Free
DIASCA	Digital Integration of Agricultural Supply Chains Alliance
DPI	digital public infrastructure
DIASCA	Deforestation and Conversion Free
EU CoC	EU Code of Conduct on agricultural data sharing by contractual agreement
EUDR	EU Regulation on Deforestation-free Products
ESG	environmental, social, and governance
FAIR	Findable, Accessible, Interoperable, Reusable
FAO	Food and Agriculture Organization of the United Nations
FSC Trace	Forest Stewardship Council traceability platform
FDaP	Forest Data Partnership
FPIC	free, prior and informed consent
GDPR	General Data Protection Regulation
GIS	geographic information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH [German Corporation for International Cooperation]
GODAN	Global Open Data for Agriculture and Nutrition
GPS	global positioning system
IDH	Sustainable Trade Initiative
ISEAL	International Social and Environmental Accreditation and Labelling Alliance
OCAP	Ownership, Control, Access, and Possession
OECD	Organisation for Economic Co-operation and Development
PbN	Preferred by Nature
PDP	personal data protection
RSPO Prisma	Roundtable on Sustainable Palm Oil Traceability system
SBP DTS	Sustainable Biomass Program Data Transfer System
SSI	self-sovereign identity
UKFRC	UK Forest Risk Commodities Regulation
USAID	United States Agency for International Development
VPA	voluntary partnership agreement
WCA	World Programme for the Census of Agriculture
WRI	World Resources Institute

Executive summary

Digitalization has transformed supply-chain governance, pushing traceability and compliance requirements deep into the "first mile". New regulations, including the European Union Deforestation Regulation (EUDR), along with corporate reporting and certification systems, now depend on detailed data from the farm, including geolocation and proof of legality. As these farm data demands increase, smallholders progressively bear the operational burden of data provision, while data use and sharing practices remain unclear, and protection under personal data laws remain uneven.

This scoping study examines how smallholder[1] farmers' production plot data is collected, governed, and shared in commodity supply chains. It synthesizes emerging practices that can better protect farmers' interests, while enabling sustainability and due diligence objectives. Anchored in case studies from Colombia (cocoa), Kenya (coffee), Viet Nam (rubber), Indonesia (palm oil), and Brazil (soy), the report unpacks both the concrete mechanics of farm-level data flows and the higher-level governance levers – voluntary commitments, fit-for-purpose regulation, and digital public infrastructure (DPI) – that can drive more equitable outcomes. It argues for a farmer-centric redesign of data systems and enabling technology – from the moment plot data is collected, through data management and sharing. It makes the case that without explicit responsibilities for "context setters" (regulators, standard owners, corporate rule makers), current practice risks propagating existing inequities in global agrifood chains. By identifying good practices for the collection and sharing of production plot data, this scoping study provides an actionable foundation for supply chain actors to advance sustainability goals with fair and equitable treatment of smallholders.

What data is collected and why

The report distinguishes three broad categories of smallholder data: (1) identification data for farmers and farms (including unique identifiers [IDs] and geospatial data); (2) farm operations data (production, inputs, land tenure, environmental attributes); and (3) trade and transactional records that anchor traceability claims. Each type is collected for overlapping purposes – regulatory compliance, risk assessment, certification, market access, advisory services, and public policy – creating complex, multiuse datasets that circulate in both public and private domains.

The smallholder risk landscape

The expansion of production plot data demands has exposed a variety of immediate and structural risks for smallholders. At the practical level, farmers face transaction costs and time burdens associated with repeated surveys and mapping exercises, often with little compensation; they also face exposure to unintended uses (tax enforcement, land dispossession risks, price discrimination) when sensitive farm data travel beyond the original compliance purpose. Vendor lock-in and platform dependency further limit autonomy: once data is captured into proprietary systems, interoperability gaps and weak portability rights can tether farmers to specific buyers and service providers. Exclusion is a notable risk, meaning that farmers unable or unwilling to meet digital compliance conditions can be shut out from higher value markets. Finally, technology bias and misclassification in remote sensing and algorithmic tools can misread agroforestry, miss context, or flag false non-compliance, with limited grievance redress mechanisms. These risks for smallholders are magnified by low digital literacy, weak representation in rule setting, and the prevailing asymmetries of bargaining power in commodity chains.

From abstractions to good practices: the data life-cycle lens

Rather than centring debates on abstract and contested concepts (such as "ownership" and "sovereignty") alone, the report organizes good practice around the tangible steps of the data life cycle: consent at collection, management (access, use, protection), and sharing (including portability and interoperability).

Consent

In many contexts, consent is nominal: buried in membership paperwork, delivered verbally in non-local languages, or implicitly coerced because services or market access is conditional on accepting broad data terms. The study consolidates implementable principles: consent should be freely given, informed, specific, explicit, recorded, and revocable; if new uses emerge, re-consent is required. Guidelines include pre-collection socialization, scripted explanations in local language, modular consent options for distinct data uses, and farmer-facing copies of consent notices. This report also encourages the recognition of collective dimensions of plot data – where one polygon reveals information about neighbouring farms and landscapes – and proposes cooperative and community representation in consent and governance to mitigate purely "individualist" framings of rights.

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[1] Smallholder farmers are defined as producers managing limited, often family-farmed plots (typically under 10 hectares), focusing on subsistence or small-scale market production using, in many cases, traditional methods and family labour (FAO, 2013).

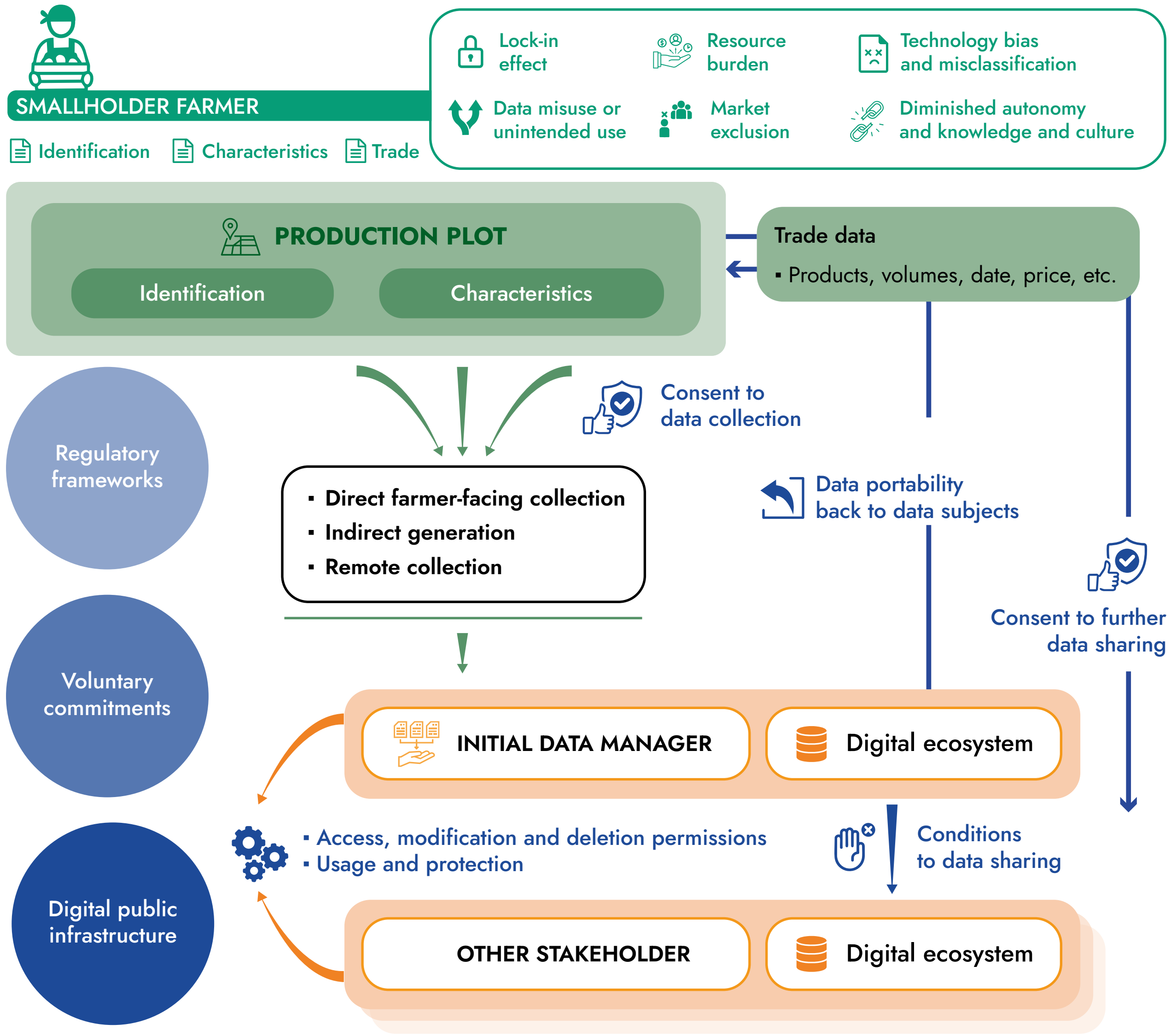
Management

Once data enter systems, permissions – who can view, modify, delete, and use – must be documented and enforced. Smallholders should, at minimum, have a clear, accessible channel to view their records and request corrections or deletion, and there should be transparent policies on retention, breach notification, and security (encryption, access control, audits). In practice, many systems lack farmer interfaces or grievance redress mechanisms, and responsibilities are fragmented across platform providers, traders, and public registries. Better defining and aligning internal data policies is a foundational step emphasized in the study.

Sharing, portability, interoperability

Because traceability and market access often depend on multiparty data exchange, the report underscores consented, purpose-bounded data sharing, governed by formal agreements that carry forward the initial data manager commitments (acceptable use, security, onward sharing restrictions). It encourages data minimization and deidentification techniques when precise attributes are not strictly necessary, and it calls for auditable records of where data goes – vital for revocation and grievance handling. Portability and interoperability are central to counter lock-in and to strengthen farmers' bargaining power: standardized formats and open protocols enable data to move across services and back to the farmer (such as providing polygon files or human-readable summaries). See Figure ES.1 that highlights key steps and governance elements in the smallholder data life cycle.

Figure ES.1 Key steps and governance elements in the smallholder data life cycle


SMALLHOLDER FARMER
Identification
Characteristics
Trade
Lock-in effect
Resource burden
Technology bias and misclassification
Data misuse or unintended use
Market exclusion
Diminished autonomy and knowledge and culture
PRODUCTION PLOT
Identification
Characteristics
Trade data
▪ Products, volumes, date, price, etc.
Consent to data collection
Regulatory frameworks
Voluntary commitments
Digital public infrastructure
▪ Direct farmer-facing collection
▪ Indirect generation
▪ Remote collection
Data portability back to data subjects
Consent to further data sharing
INITIAL DATA MANAGER
Digital ecosystem
▪ Access, modification and deletion permissions
▪ Usage and protection
Conditions to data sharing
OTHER STAKEHOLDER
Digital ecosystem

Source: Produced by authors.

The accountability gap: responsibilities of context setters

A recurring critique is the limited formalization of governance responsibilities for those who set the rules – regulators, standard owners, and corporate buyers who create or impose data requirements. Existing frameworks articulate principles (transparency, accountability) but fall short of defining duties and safeguards for the rule makers themselves. The report calls for explicit responsibilities regarding proportionality (collect only what is necessary), fairness (avoid burden shifting upstream), and remedies (establish dispute resolution and breach notification accessible to smallholders). Without such accountability, data architectures risk reproducing asymmetries under a veneer of neutrality. The report calls for explicit responsibilities regarding proportionality (collect only what is necessary), fairness (avoid burden-shifting upstream), and remedies (establish dispute resolution and breach notification accessible to smallholders).

Overarching approaches

Building on the data life-cycle lens, the report identifies three complementary levers that can systemically improve smallholder data governance.

Voluntary commitments and cooperative instruments

Multistakeholder governance frameworks – such as trust frameworks, sectoral codes of conduct tailored to production plot data, organizational data policies published by scheme owners and buyers, and standardized data sharing agreements – can help to improve the standard of practice. Crucially, these instruments must be co-designed with farmer organizations and resourced for uptake; otherwise, their voluntary nature risks favouring dominant actors. Collective grievance and redress mechanisms that transcend single organizations are highlighted as a missing piece: farmers often need somewhere to challenge algorithmic flags or exclusion decisions when data have propagated through multiple systems.

Fit-for-purpose legal frameworks

Personal data protection laws (such as regimes like the General Data Protection Regulation [GDPR]) are spreading globally and offer enforceable rights – data access, correction, erasure, portability – but many farm and geospatial data points fall outside their scope when not directly tied to identifiable persons or when anonymized. The report recommends regulatory alignment across jurisdictions, sector specific-guidance for agricultural data, and participatory drafting that includes smallholders. It notes that even strong rights on paper are ineffective without enforcement capacity or digital literacy; legal advances, such as the European Union Data Act, which focus on non-personal data generated by devices, are promising but must be tailored to smallholder contexts.

Digital public infrastructure (DPI)

As a "high trust, low cost" backbone, digital public infrastructure (DPI) can reduce fragmentation, standardize exchange, and democratize access to tools and datasets – registries, digital IDs, open standards, and public geospatial layers. Open-source traceability platforms and GeoID approaches can make anonymized plot reference data widely usable while curbing sensitive attribute leakage. However, DPI is not a panacea – inclusion, usability, governance safeguards, and sustainable funding models are prerequisites to avoid reproducing biases or surveillance. The study urges farmer-centric DPI design, with interfaces that support data portability back to farmers and grievance channels at scale and recommends exploring farmer data wallets and credentials like self-sovereign identity (SSI) to return agency to data originators.

Case-based insights

Five case studies offer grounded perspectives on both progress and gaps:

- **Cocoa: Colombia –** In the absence of a unified public platform for deforestation-free compliance, federations and companies lead data efforts. The nationwide census and georeferencing of the National Federation of Cocoa Farmers (Fedecacao) illustrates the potential of cooperative stewardship: informed consent is documented, and anonymization is planned for external data sharing to meet EUDR needs. Trust-building – via livelihood benefits rather than formal notices alone – proved decisive for participation.
- **Coffee: Kenya –** Kenya is consolidating farmer registration and coffee plot mapping under the Kenya Integrated Agriculture Management Information System (KIAMIS) and a national information system which maps farmers' details with explicit governance frameworks that operationalize consent templates, complaint procedures, and security controls. Cooperatives remain critical conduits but face capacity constraints and data fragmentation; farmer access to their records is not yet systematic, and alignment between state-led mapping and private certification systems is a work in progress.

- **Rubber: Viet Nam –** A multilayered agent-mediated supply chain complicates consent and accuracy; data collection is often informal, and enforcement of personal data protections is uneven. Where enterprises invest in integrated geographic integration system (GIS) and traceability with role-based controls, governance improves, but smallholder inclusion remains limited. Legal gaps on non-personal and pseudonymous data create ambiguity in accountability when many entities process farm information.
- **Palm oil: Indonesia –** Multiple registries and certification systems coexist (Surat Tanda Daftar Budidaya [STDB] [plantation cultivation registration certificate], Indonesian Sustainable Palm Oil [ISPO], corporate platforms), with smallholders often navigating paper-based processes and district-level variability. Corporate programmes, supported by service providers, demonstrate rigorous consent workflows and differentiated data sharing, yet revocation pathways can be impractical (such as email-only). A national dashboard for sustainable commodity data is under development to integrate systems without centralizing ownership, but custodianship and governance are still being defined.
- **Soy: Brazil –** The Rural Environmental Registry (CAR) anchors plot-level environmental information and offers producer interfaces for corrections, but integration with production and trade data is incomplete and small producers' awareness of data use is limited. Despite protection similar to the GDPR (Brazilian General Data Protection Law [LGPD]), enforcement in agricultural contexts is inconsistent.

Implications for practice

Credible smallholder-oriented data governance cannot be added as an afterthought to compliance architectures; it must be designed into systems at the outset. Three implications stand out:

- Consent must be meaningful and explicit at every step of the data life cycle.
- Permissions and redress must be operationalized. Farmers should have straightforward ways to see, correct, and retrieve their data.
- Portability and interoperability are not optional. To counter lock-in and enhance bargaining power, data should be provided back to farmers in standard formats and human-readable summaries, and sectoral actors should converge on open standards and application programming interfaces (APIs); DPI can lower costs and raise baseline capability, but its architecture must embed farmer-centric design and safeguards to avoid reproducing silos or biases.

Recommendations

The following priority actions emerge for different actor groups:

- **Regulators, standard owners and system owners (context setters):** codify roles and responsibilities; ensure farmer inclusion in rule design; align definitions and rights across jurisdictions to reduce compliance ambiguity; and issue sector-specific guidance on when farm geo-data is personal or non-personal, as well as how deidentification can be applied.
- **Commodity buyers, traders, and certification systems:** develop and publish organizational data policies; adopt modular consent; use data-sharing agreements that propagate restrictions; minimize attributes when sharing; provide data back to farmers through appropriate means; support cooperative governance where feasible; and require suppliers to meet baseline governance practices, but account for resource constraints and co-finance capacity building.
- **Producer organizations and cooperatives:** act as trusted intermediaries for consent and data stewardship; negotiate data terms collectively; offer grievance channels; and invest in digital literacy and simple interfaces that return records to farmers; and explore data wallets or member cards to anchor portability and identity across services.
- **DPI and open-source communities:** prioritize building blocks that immediately reduce friction (farmer data wallet systems, plot registries with GeoIDs, standardized vocabularies, secure sharing protocols); embed usability for low-connectivity contexts (printable PDFs, short message service [SMS] summaries); pilot grievance and redress at network scale; and pursue sustainable funding models that mix public finance and private contributions.

Limitations and future directions

The report acknowledges that even robust governance cannot erase structural inequalities in commodity markets. Digital systems exist within political economies that allocate value and risk unevenly; farmer-centric data governance can mitigate harm and enhance agency but will not rebalance pricing or rectify market concentration on its own. Further, retroactive governance poses a practical dilemma: how to treat historical datasets collected under older, thinner consent when new rules emerge. The study encourages multisector dialogues on whether and how to limit the reuse of legacy data, as well as creating transition pathways that respect both compliance timelines and farmers' rights. Rights-based data governance can mitigate harm and enhance agency, but will not – on its own – rebalance pricing or rectify market concentration.

Conclusion

To make deforestation-free and rights-respecting supply chains a reality, data governance must be as farmer-centric as the compliance systems are data-centric, which means: designing consent processes that are truly voluntary and intelligible throughout the data life cycle; enforcing permissions, protection, and purpose-limited sharing; ensuring portability and interoperability; and, above all, assigning explicit responsibilities to those who require the data. When voluntary instruments, legal frameworks, and DPI are mobilized together – anchored in inclusive design and digital literacy – smallholders can participate in global markets on fairer terms, with their data becoming a pathway to livelihoods and resilience rather than a conduit for extractive or exclusionary practices. This report provides a practical blueprint for that transition, anchored in real supply-chain contexts with actionable steps that organizations can adopt while contributing to longer-term system change.

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Introduction

The rise of digitalization and data systems is permeating all economic sectors globally, including the agricultural and forestry sectors. Concepts such as digital agriculture (AgTech) and information and communication technology (ICT) for agriculture have been developed and discussed for decades, holding the potential to address multiple challenges. Sustainability objectives and due diligence practices have been part of this general movement, with the specific note that data linked to agricultural or forestry production may be distributed and copied extensively throughout supply chains up to consumer markets.

Regulatory requirements, such as the European Union Deforestation Regulation (EUDR)[2] (European Union, 2023), are driving the need to collect data and strengthen traceability in commodity supply chains. This is further necessitated by voluntary certification schemes – such as the Sustainable Biomass Programme's Data Transfer System (SBP DTS), Roundtable on Sustainable Palm Oil (RSPO) Prisma, Forest Stewardship Council (FSC) Trace – and national-level initiatives. These latter initiatives include legality assurance systems (LAS),[3] such as Indonesia's Timber Legality Assurance System (SVLK), and other national systems (such as Romania's Sistemul Informatic Integrat de Urmărire a Materialelor Lemnoase [Integrated Information System for Wood Tracking] [SUMAL] and the Ghana Cocoa Traceability System [GCTS]).

To meet these growing requirements, a wide array of actors is involved in data collection, management, and sharing, including the private sector, government agencies, producers and producers' groups, certification actors, and civil society. These stakeholders are increasingly collecting data on the production of relevant agricultural or forestry commodities, including smallholder producers' plot-level data, which is the focus of this report. Smallholders are understood as small-scale farmers or farming households managing a relatively small plot of land (usually under 12 hectares), frequently relying on family labour.

While the transition to digitized and data-driven supply chain governance offers new opportunities for market access, it also exposes smallholders to additional burdens and risks. While data requirements seldom apply directly to producers, they are ultimately the custodians of their farm-related data and, therefore, frequently incur the additional burden of providing this information to the various stakeholders who request it. Furthermore, the lack of safeguards and the ambiguity of data requirements may permit unfair or unethical practices, for instance, pressuring smallholders to share excessive personal data without clear consent, transparency, or benefit-sharing arrangements.

These issues point to persistent power imbalances between smallholders and data handlers. Smallholders may lack awareness of what data is being collected, how it is used, or who profits from it. This asymmetry risks reinforcing existing inequities within global supply chains (European Union Code of Conduct, 2018; Fripp *et al*., 2023). More efficient governance models are highly needed to enable equitable access, foster inclusion, and build trust in digital agricultural systems (FAO, 2021a). Because the governance responsibilities of those who set data requirements are rarely formalized and seldom defined in existing regulations or frameworks, smallholders and their representatives are almost never involved in shaping data systems, leaving their rights and perspectives largely absent from farm data governance.

To address these emerging challenges, this report examines what constitutes appropriate data governance for smallholders' production plot data. While there is currently no broad consensus on the exact definition of data governance, it can be defined as a set of policies, responsibilities, roles, and practices that apply to data and determine who can do what, when, and how with which data.

It is intended for stakeholders involved in data collection and traceability systems, including: commodity traders, processors, and certification managers; government agencies developing or regulating registries; information technology (IT) solution providers; and smallholder representatives and cooperatives. It also speaks to civil society groups, development partners, and researchers working to promote inclusive, rights-based data governance in agricultural supply chains.

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[2] Regulation (EU) 2023/1115 of the European Parliament and of the Council of 31 May 2023 on the making available on the European Union market and the export from the European Union of certain commodities and products associated with deforestation and forest degradation.

[3] Legality Assurance Systems are frequently driven by and embedded in Voluntary Partnership Agreements (VPAs) negotiated with the European Union.

The study is organized as follows:

- **Section 1** provides a general overview of data collected from smallholders in agricultural and forestry supply chains, as well as why and how it is collected. It highlights the specificities of data collected for sustainability and due diligence objectives.
- **Section 2** identifies the different risks that smallholders may face, including immediate practical consequences and broader issues of unfairness and inequity.
- **Section 3** unpacks the different practices associated with data at each stage of the farm data journey, including its collection, access, use, and sharing. It addresses existing challenges at each step and highlights good practices and existing solutions.
- **Section 4** highlights broader approaches that can leverage and incentivize better practices around data governance.
- **Section 5** provides conclusions.
- **Section 6** presents a series of case studies:
  - Cocoa: Colombia
  - Coffee: Kenya
  - Rubber: Viet Nam
  - Palm oil: Indonesia
  - Soy: Brazil
- **Annex 1** provides a selection of key resources organized by focus topics.

Key concepts regarding data governance

Data governance

It commonly refers to the arrangements through which authority over data is exercised – how decisions on access, use, and sharing are made, and by whom (Janssen *et al.*, 2020; Taylor, 2017). The Organisation for Economic Co-operation and Development (OECD, 2021) describes it as the rules, norms, and institutions guiding data management, while the **Sustainable Trade Initiative** (IDH, 2023) emphasizes the technical, policy, regulatory, and institutional provisions affecting the entire data cycle – from creation to deletion.

Some intra-organizational perspectives restrict data governance to the internal rules implemented by a single organization. The **International Social and Environmental Accreditation and Labelling Alliance** (ISEAL, 2020a) defines data governance as “the collection of practices and processes used to ensure formal management of data assets within an organization”. Intra-organizational efforts to establish and implement better rules are important, but in a context where data flows across companies, supply chains, and national borders, data governance should extend to a broader, more holistic level. The term “data management” is more helpful to refer to the concrete application of policies and practices at a single organization’s level (USAID, 2023).

Another frequently used term is “data stewardship”, which upholds a stronger dimension of quality and reliability as well as responsible collection and use of data, including toward individuals and communities (USAID, 2023).

Data ownership

This concept is still very frequently used (European Commission, 2024), in particular to defend smallholders’ ownership of their own data. However, unlike material resources, data is intangible and easily replicated, which challenges traditional notions of ownership. Although access can be restricted, the ease of duplication and distribution makes it difficult to control circulation. In Ostrom’s terms, data might function as a public good, though restrictions may render it a club good (Hess and Ostrom, 2007). Moreover, data is often co-generated by multiple actors – including farmers, service providers, and processors – making ownership debates less relevant than the allocation of specific permissions and responsibilities toward such data (Carroll *et al.*, 2020; FAO, 2021a).

Data rights

Rights can be legal, social or ethical forms of entitlement – they refer to rules about what is allowed, or what is owed to individuals. In the context of data governance, the mention of rights can therefore reference legal rights (such as the right for data subjects to access their information enshrined in the GDPR), or more social or ethical rights ("smallholders should have the right to benefit from their own data"). Rights may also exist on paper without being enforced in practice, and some argue that rights only exist to the extent that they can be exercised or defended.

In addition, in IT environments, "rights" tend to refer to technical permissions given to individuals or groups of individuals (such as access rights or editing rights), not referring to any legal or moral stance. In that context, the term "rights" is more akin to the ability to do something.

Data sovereignty

Data sovereignty refers to the principle that data is subject to the governance structures, laws, and authority of the jurisdiction in which they are generated, stored, or processed. It is commonly discussed in relation to state control over data infrastructure, access, and transnational flows.

Within Indigenous Peoples scholarship and governance debates, data sovereignty increasingly denotes the right of Indigenous Peoples to control the collection, ownership, application, and stewardship of data derived from their lands, resources, and communities (FAO, 2021b).

Lastly, it is also sometimes used from an individual perspective, as "the capability of an individual or an organization to exercise control over their personal and business data" (GIZ, 2022). This meaning is linked to the concept of self-sovereign identity, in which individuals control the information used to establish their digital identity.

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1. Overview of data collected from smallholders

Whether for sustainability purposes or for other purposes, a wide array of data may be collected from smallholder farmers; this data and its associated systems are increasingly complex and serve various purposes.

This section offers an overview of the type of data that may be collected (What is collected – Section 1.1). It then summarizes how sustainability objectives and due diligence requirements are specifically influencing the need for such data (Why is data collected – Section 1.2); it also highlights how it is usually collected, both in terms of practices and supporting systems (Section 1.3).

This overview provides the necessary foundation to discuss the potential unintended risks faced by smallholders whose data is collected (Section 2), as well as explore improved practices around how the data is collected (particularly concerning consent acquisition – Section 3.1) and how it is used and shared (Section 3.2 and Section 3.3).

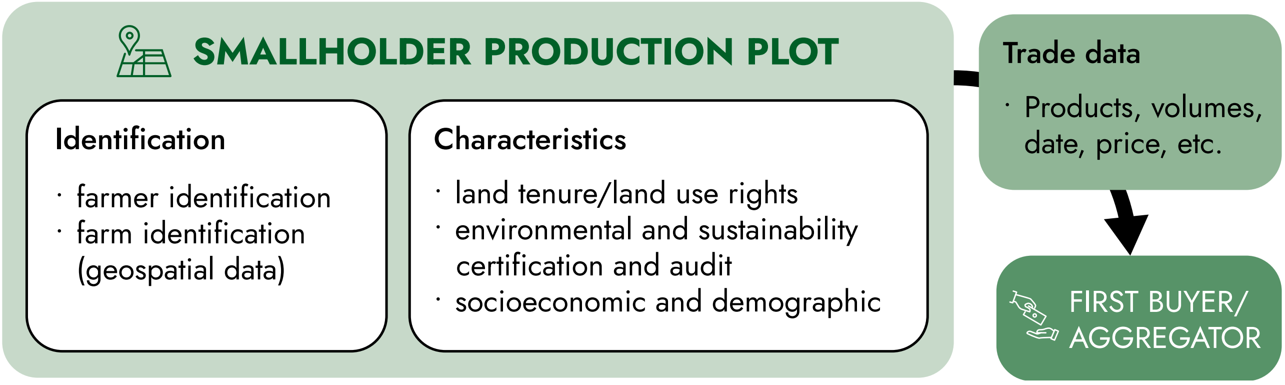
1.1. What data is collected from smallholders?

As highlighted in Figure 1, production plot data collected from smallholders can be divided into two broad categories:

- data intended to identify a particular farm or farmer (Section 1.1.1); and
- data intended to capture the various characteristics of that farm (Section 1.1.2).

In addition, trade or traceability data from the farm to the first buyer or aggregator may also be captured to ensure the connection between commodities and goods traded in supply chains to the production plot of origin (Section 1.1.3).

Figure 1. Type of production plot data collected


SMALLHOLDER PRODUCTION PLOT
Identification
· farmer identification
· farm identification (geospatial data)
Characteristics
· land tenure/land use rights
· environmental and sustainability certification and audit
· socioeconomic and demographic
Trade data
· Products, volumes, date, price, etc.
FIRST BUYER/ AGGREGATOR

Source: Authors' own elaboration.

1.1.1. Farmer and farm identification data

These data points serve to identify a specific farm or farmer. Within due diligence systems, farm or farmer identification is key to link agricultural or forestry production to a specific production plot of origin. This identification also increasingly leads to the attribution and later use of unique identifiers.

Farmer identification data

Farmers can be identified through their personal information, such as their name, age, gender, contact details, fingerprints, and photographs (FAO, 2021a). Personal banking information can also be recorded, including to facilitate payments to farmers. These data points would constitute personal data in most jurisdictions, insofar as they are clearly linked to an identified individual. Personal data is increasingly protected by regulatory frameworks (see Section 4.2).

In Kenya, farmers are registered in KIAMIS, including their bio-data (age, gender, personal identification, etc.) (Kenya Ministry of Agriculture and Livestock Development, 2024) (see Section 6.2).

Farm identification and geospatial data

Information about where a farm is located is increasingly collected and shared across supply chains. It can be used in conjunction with farmer identification or independently. Information ranges from simple, text-based information (village, area, address) to more elaborate geospatial data.

Geospatial data typically comes in the form of coordinates (one or several points) or mapped boundaries. It is used to precisely locate production areas. A differentiation is sometimes made between farm boundaries and plot boundaries, as a farm may include several adjacent or non-adjacent plots.

The specificities of geospatial data

Geospatial data is usually stored in electronic files with specific digital formats that enable its management in geographic information software and systems (such as shapefiles, GeoJSON, KML/KMZ, GeoPackage, and CSV files).

Under the EUDR, data must be submitted in GeoJSON format, with a feature class structure and at least six decimal places of precision. The European Commission provides technical specifications for geometry and file structure.

It is important to note that these file formats allow the storage of non-spatial information attached to geographic features. These are called data attributes or properties. For instance, a geospatial file can contain a list of farm boundaries with associated details such as farmer ID, planted crops, etc.[4]

It is debated whether farm identification always constitutes personal data: in some instances, geospatial data for a farm may be entirely anonymized, in which case some would argue that it cannot be linked to an identified or identifiable individual (see Section 4.2 for an overview of personal data protection legal frameworks). Additionally, vast amounts of satellite imagery of the whole planet are available to the general public and plot locations and boundaries can be inferred from these public resources.

Brazil's CAR, the national rural environmental registry managed by the Ministry of Environment, is mandatory for all rural properties and includes georeferenced plot boundaries (see Section 6.5).

Unique identifiers for farms and farmers

Unique identifiers for both farms and/or farmers are frequently used, in combination with established registries (World Bank, 2018). State actors and private sector entities have been developing such registries, which attribute unique identifiers to farmers or farms, attached to a series of core information about these individuals and their production areas. Subsequent data collection efforts are facilitated by referencing these unique identifiers.

In Ghana, cocoa producers have been allocated unique identifiers for their production plots. When a farmer manages several non-adjacent production plots, they have been given distinct identifiers. These identifiers are colour-coded to facilitate proper reference by the producer at the first sale/aggregation point (Cocobod, personal communication, 2025).

When it comes to providing IDs for specific geographic locations, GeoIDs can also function as permanent digital fingerprints linking a specific location to geospatial information and other information (crop type, farmer identity, etc.). GeoIDs can facilitate product traceability efforts, the collection of agricultural and environmental data specific to a plot, and the enablement of satellite monitoring of the farm.

Working with GeoIDs is frequently cited as a key element in data governance (GIZ and Earthworm, personal communications, 2025). Some state-led initiatives are attributing GeoIDs to farms (for instance, in India with FarmStack). Initiatives such as AgStack, developed by the Linux Foundation, are aiming at providing global, open-source, anonymous, and attribute-less geospatial identifiers, as part of collective efforts to develop DPI to address challenges, including cost and accessibility barriers (see Section 4.3).

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[4] For the purpose of differentiating data types, non-geospatial attributes should not be considered geospatial even if they are stored in geospatial file formats.

1.1.2. FARM OPERATIONS DATA

This category of data provides further specific information about how a farm operates (FAO, 2021a). These are collected for a wide range of reasons (see Section 1.2), including due diligence for sustainability or legality.

Farm production data

Farm production data reflect the farm's operational characteristics. These may include crop type, cultivated area, production system, input use (such as fertilizer or pesticides), planting and harvest dates, and yield or quality data.

In the context of sustainability objectives, these can be used to establish the legality of production operations (such as no use of prohibited pesticides or timber harvest within the prescribed period). Yields can also be corroborated with the production area to mitigate risks of contamination from other undeclared production areas (for example, purchases from a single farm going well above expected annual yields may indicate contamination with crops produced in a nearby protected area where agriculture is not allowed).

Land tenure and land-use rights data

While farmers may be both the producer and the landowner, they may also be deriving their right to cultivate land from a distinct individual landowner or from a collective entity such as the village community. Data on the type of land tenure, the identity of the landowner (if different from the farmer), as well as legal ownership or land-use rights documents, may be collected.

Land tenure and land-use rights data is especially important in the context of the EUDR, as European operators importing relevant commodities must demonstrate that production complies with the relevant legislation of the country of production (Regulation European Union 2023/1115, Article 2[40][a]).

Environmental and sustainability data

Environmental data capture both the physical condition of the farm and its land-use practices. Typical data points include forest cover, legal reserves, soil type, water sources, and agroecological practices. Additional metrics may include greenhouse gas emissions or biodiversity indicators.

Brazil's CAR system requires a declaration of conservation areas and legal reserves (Roitman *et al.*, 2018).

Certification and audit data

Information about the certification schemes the farm is under (whether voluntary or government-mandated) may also be collected. This may consist of certificate number, certificate, audit dates, audit reports, etc. Farmer groups or cooperatives managing sustainability certificates may be the organization dedicated to collecting this data from all individual farms or farmers within the group.

Socioeconomic and demographic data

These data provide context on the farmer's household and livelihood situation. Variables include household size, education level, income level and sources, cooperative membership, and participation in training. Some systems also measure access to credit and formal banking services (USAID, 2018; World Bank, 2018).

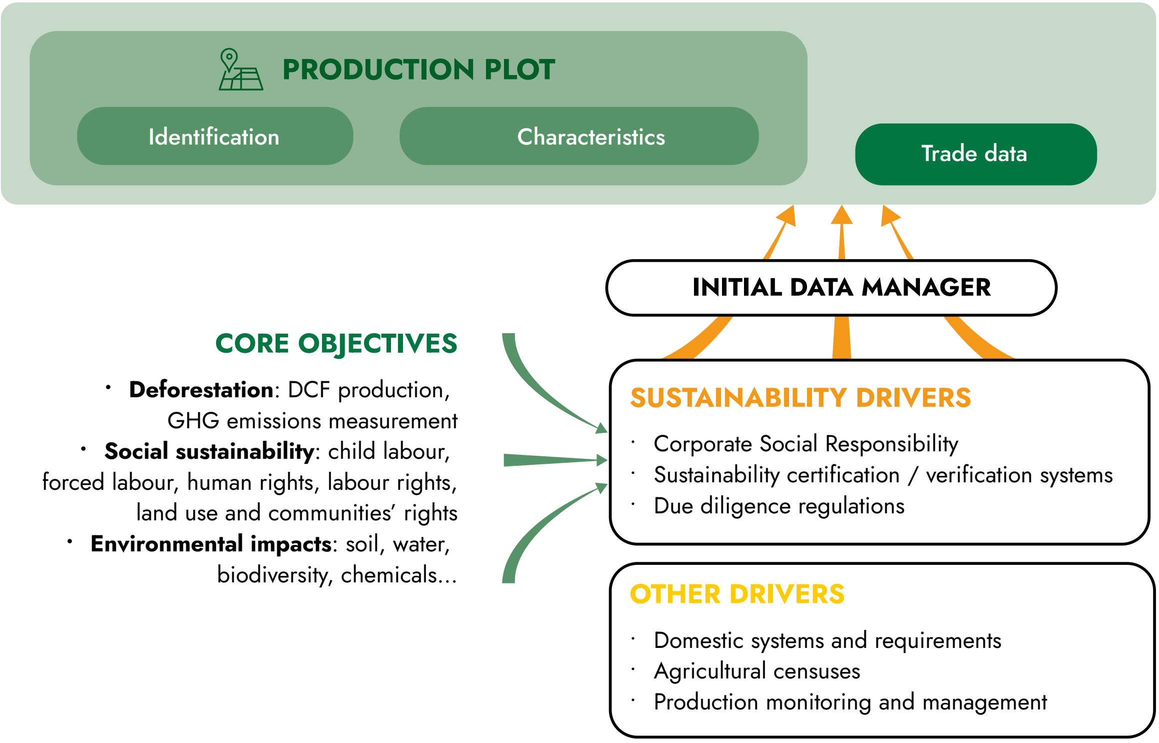
1.1.3. TRADE DATA

Finally, trade data may be collected from smallholders. However, this type of data is not specific to this category of actor and is usually collected throughout supply chains, particularly for the purpose of product traceability. Trade data collected from farmers may consist of product type, volume sold, transaction date, invoice or receipt, buyer identity, quality elements, etc.

1.2. SUSTAINABILITY AND DUE DILIGENCE AS DRIVERS FOR FARM DATA COLLECTION

This section highlights the different drivers for farm data collection. It focuses on sustainability and due diligence drivers, particularly through the implementation of corporate social responsibility (CSR), sustainability verification, and certification systems, as well as due diligence regulations. All these approaches are underpinned by various sustainability objectives, which are highlighted. The section also provides a brief overview of farm data collection drivers, not specifically or solely focusing on sustainability objectives. Figure 2 highlights main drivers for production plot data collection.

Figure 2. Drivers for production plot data collection


PRODUCTION PLOT
Identification
Characteristics
Trade data
INITIAL DATA MANAGER
CORE OBJECTIVES
• Deforestation: DCF production, GHG emissions measurement
• Social sustainability: child labour, forced labour, human rights, labour rights, land use and communities' rights
• Environmental impacts: soil, water, biodiversity, chemicals…
SUSTAINABILITY DRIVERS
· Corporate Social Responsibility
· Sustainability certification / verification systems
· Due diligence regulations
OTHER DRIVERS
· Domestic systems and requirements
· Agricultural censuses
· Production monitoring and management

Source: Authors' own elaboration.

1.2.1. OVERALL SUSTAINABILITY OBJECTIVES DRIVING FARM DATA COLLECTION

Whether fully voluntary, market-based, state-mandated, or civil society and advocacy-led, efforts to better understand and report on commodity production impacts result from one or a combination of the following core sustainability objectives:

- Reducing deforestation, which extends to the conversion of other ecosystems: this applies notably to the objective of producing deforestation and conversion free (DCF) commodities. Greenhouse gas emission measurement also drives, to a certain extent, the collection of relevant production information in the broader context of climate change.
- Ensuring social responsibility for produced commodities: for example, child labour has emerged as a significant issue in the cocoa sector. Forced labour, and more generally human rights and labour rights, are also important in farm monitoring, with a varying degree of challenge depending on commodities and geographies. Social responsibility can also be extended to the monitoring of land grabbing practices, as well as upholding rights and ensuring free, prior and informed consent (FPIC) to produce commodities on lands and territories of Indigenous Peoples.
- Other environmental impacts, such as soil health, water usage, the protection of biodiversity, and high conservation values.

1.2.2. CORPORATE SOCIAL RESPONSIBILITY (CSR) AND ENVIRONMENTAL, SOCIAL, AND GOVERNANCE (ESG)

Companies increasingly seek to demonstrate sustainability and responsible sourcing. Corporate social responsibility and reporting efforts sometimes concentrate on direct suppliers and/or large processors along supply chains. In the agricultural and forestry sectors, however, companies' sourcing policies and obligations have been driving unprecedented levels of traceability up to production areas, as well as the collection of information related to the production of traded commodities.

Corporate social responsibility regulatory requirements are one factor influencing the need for companies to better understand their sourcing and measure their impact (such as European Union Corporate Sustainability Reporting Directive CSRD]).[5, 6] Civil society and advocacy organizations have also implemented monitoring and accountability mechanisms that push private sector organizations to collect more information on their supply chains up to production at the farm level. Examples include companies' scoring, such as the Carbon Disclosure Project (CDP) Forest Score, Forest500 and Zoological Society of London Sustainable Palm Oil Transparency Toolkit (ZSL SPLOTT).[7] Topics companies must report on often include aggregated information, such as greenhouse gas emissions arising from land-use change, the percentage of commodities sourced being verified as deforestation and conversion free (DCF), volumes traceable to the plantation level, and the number of smallholders supported in specific programmes.

1.2.3. SUSTAINABILITY VERIFICATION OR CERTIFICATION SYSTEMS

Farm mapping and other farmer or farm-specific data is also required to comply with sustainability systems, including voluntary (such as Rainforest Alliance), mandatory state-led certification systems (such as ISPO) as well as other verification systems and buyer-specific protocols and standards (such as Volcafe).

These various sustainability systems frequently require proof of exclusion from protected areas, buffer zone integrity, or agroforestry practices. Spatial data may be independently verified, in particular in third-party voluntary schemes (such as Rainforest Alliance).

Government-led, mandatory certification systems also mandate the collection of farm-specific information.

In Indonesia, the government-led certification system ISPO[8] is being extended to smallholders and requires plantations' business registration through the STDB registration. The STDB registration includes geolocation recording (see Section 6.4).

1.2.4. DUE DILIGENCE REGULATIONS IN CONSUMER MARKETS

Emerging due diligence regulations in consumer markets – such as the EUDR, the Corporate Sustainability Due Diligence Directive (and European Union CS3D)[9], the United Kingdom Forest Risk Commodities Regulation (UK FRC)[10], and new forced labour prevention laws – are becoming major drivers for extensive data collection at the production level. These frameworks share a common objective: ensuring that commodities entering regulated markets comply with environmental, social, and legal standards.

Some of these regulations require traceability to the production plot, which translates into collecting geolocation data and mapping farm boundaries. This information underpins risk assessments for deforestation, legality, and human rights compliance. For example, operators and traders must demonstrate that commodities are free from deforestation, produced legally under domestic frameworks, and not linked to forced or child labour.

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[5] Directive 2022/2464 on corporate sustainability reporting.

[6] Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on corporate sustainability due diligence.

[7] Some of those company-specific data and metrics on deforestation performance are consolidated in the ForestIQ tool.

[8] Presidential Regulation No. 44/2020; Minister of Agriculture Regulation No. 38/2020.

[9] Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on corporate sustainability due diligence.

[10] Introduction of forest risk commodities regulations.

Beyond geospatial data, compliance frequently requires additional evidence, including:

- **land tenure and use documentation** (titles, permits) to confirm legal production rights;
- **environmental and agronomic data**, such as pesticide use, harvest dates, irrigation practices, and machinery employed;
- **social compliance evidence**, including FPIC and proof of exclusion of child or forced labour; and
- **trade and yield information** to verify traceability and prevent mixing with unknown-origin commodities.

These requirements have led to complex and resource-intensive data collection processes, particularly for smallholder supply bases. The challenge is compounded by regulatory ambiguity on evidence standards, which often discourages adherence to data minimization principles. While producers outside regulated markets are not directly subject to these laws, importers and downstream actors must obtain this data to maintain market access – pushing the burden upstream to the "first mile".

In practice, compliance efforts have spurred national and private-sector initiatives for farm registration and mapping. For instance, some producer countries are developing integrated information systems to capture farmer details and production plot data, while industry actors leverage existing extension services to incorporate mapping and registration. These systems increasingly serve multiple purposes, from due diligence compliance to enabling payment systems, certification, and sustainability programmes.

In Colombia, the National Federation of Cocoa Farmers (Fedecacao) has implemented a nationwide smallholder census to facilitate the export of cocoa to the European Union market. The census includes georeferencing production plots as well as collecting information on almost 300 social, environmental and deforestation data variables (see Section 6.1).

In Côte d'Ivoire, mills have used existing extension service processes with their smallholders' suppliers to add plot mapping and farmer registration as additional activities (Preferred by Nature, personal communication, 2023).

In Kenya, EUDR has been an important driver for government authorities to accelerate the development of a national information system, which captures farmers' details and maps coffee production plots, under the broader umbrella of KIAMIS (see Section 6.2).

OTHER DRIVERS FOR FARM DATA COLLECTION

Domestic systems and regulatory requirements

The collection of farm-specific information – such as farm geospatial boundaries, farmers' identification and trade data – is increasingly required under some national programmes and regulatory frameworks, in order to strengthen the state's overall control over agricultural production and trade flows. Examples include Brazil's CAR or the European Union Land Parcel Identification System (LPIS).

Domestic agricultural censuses

Farm-specific data may also be collected by states implementing nationwide agricultural censuses. Collecting comprehensive data on the agricultural sector enables policymaking, planning and resource allocation at the state level, which are important for objectives as wide as ensuring food security, eradicating poverty and hunger, maintaining appropriate soil and irrigation conditions, ensuring environmental sustainability, addressing climate change, etc.

Countries participating in the World Programme for the Census of Agriculture (WCA), coordinated by FAO, are expected to conduct a national agricultural census at least every 10 years. Such datasets tend to be anonymized and aggregated, with a statistical approach that does not maintain or display farm-specific information to users.

Production monitoring and management

Another important driver for collecting farm data is to monitor and improve agricultural production at the farm or supply-area level. This information is usually sought by large players, such as major producers, traders, processors, and government agricultural agencies.

Geolocation and other farm-specific data enable digital tools to optimize inputs, monitor yields, detect risks, and provide site-specific agronomic advice. Specific platforms integrate plot-level coordinates with satellite imagery, weather data, and crop models to generate site-specific agronomic advice. This information can be used to monitor and improve productivity, assess risks, and determine eligibility for services such as finance or extension (FAO, 2021a).

The following table summarizes the principal categories of smallholder data, their drivers in commodity supply chains, and highlights how each data type serves multiple purposes.

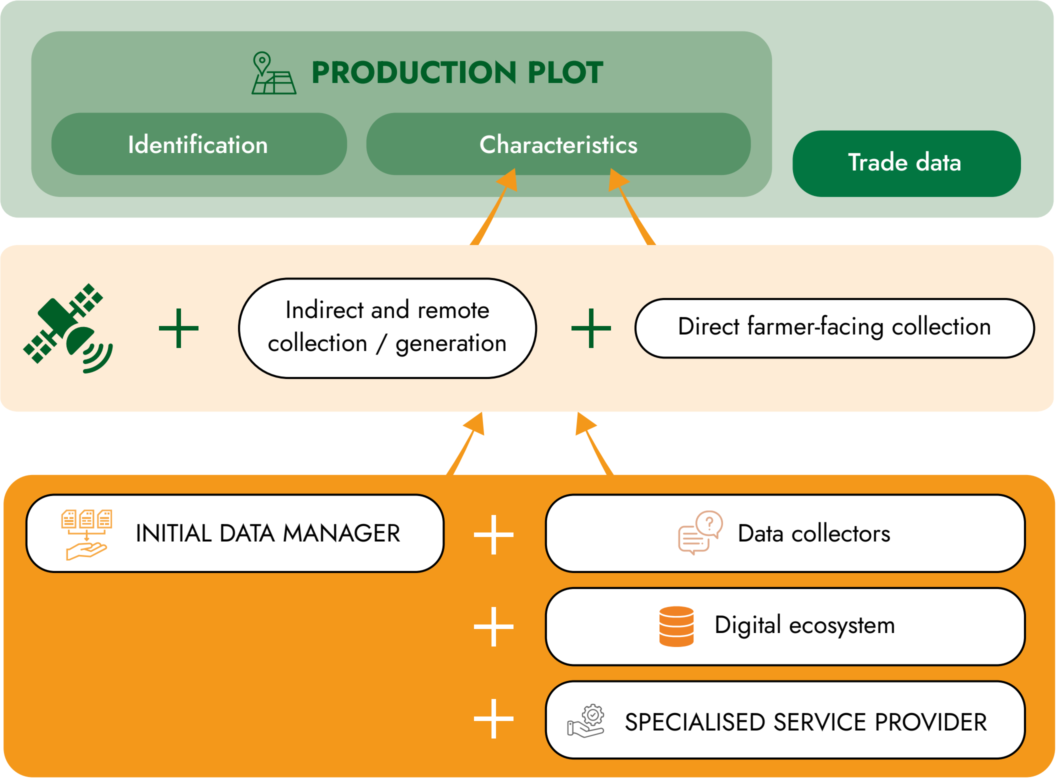
Table 1. Summary of the principal categories of smallholder data, their drivers in commodity supply chains, and how each data type serves multiple purposes

	Type of data collected	SUSTAINABILITY DRIVERS					OTHER DRIVERS		
		Regulatory compliance	Traceability	Risk assessment & monitoring	Sustainability metrics	Market access & certification	Financial inclusion & services	Farmer advisory & services	Policy & research
Identification	Personal identifiers (name, ID, phone, biometrics)	May be requested for producer registration, tax IDs, or official compliance checks	Links farmer identity to plots and product flows	Supports social risk monitoring (child labour, gender balance, migrant status)	Not usually used for environmental metrics	Required for certification registry & audits	Essential for Know Your Customer (KYC), digital finance, and mobile payments	Enables personalized advisory & extension services	Used cautiously in surveys/ demographics (subject to privacy laws)
	Geolocation (GPS, polygons)	May be required for land-use legality checks, boundary disputes, or compliance with land-use regulations	Contributes to linking the product to the exact origin	Necessary for deforestation alerts and land-use change monitoring	Provides baseline for carbon/land-use impact metrics	Increasingly requested by certification schemes	Limited role in finance (unless linked to insurance risk maps)	Useful for tailored agronomy advice (e.g. soil by location)	Crucial for land-use planning and national statistics
Characteristics	Farm production data (yields, inputs)	Rarely a regulatory requirement, but sometimes needed for pesticide/fertilizer laws	Volume/yield data ensures product flow consistency	Identifies risks of low productivity or overuse of inputs	Enables calculation of productivity, greenhouse gas, and water footprint	Basis for productivity standards in certification	Used in loan repayment capacity analysis	Critical for advisory services on yields and inputs	Contributes to agricultural statistics
	Land tenure & ownership	Legal ownership documents are often required to prove compliance with land laws	Not directly used for traceability, but strengthens the chain of custody	Identifies risks of land conflict and tenure disputes	Limited role in environmental metrics	Often required for certification eligibility	Acts as collateral for loans or access to credit	Less relevant	Supports national land registry & policy reforms
	Environmental data (soil, water, biodiversity)	May be requested in context of environmental impact assessments (EIAs) or pesticide use regulations	Not directly linked	Assesses risks to natural resources, biodiversity, soil health	Direct input to sustainability indicators (greenhouse gas, biodiversity indices)	Sometimes required in environmental standards	Limited unless linked to “green finance”	Enables climate-smart and ecosystem-based advice	Used for conservation planning and monitoring
	Certification & audit data	Directly used as evidence of compliance with voluntary or mandatory standards	Provides verified traceability documentation	Demonstrates risk mitigation practices	Tracks progress against sustainability targets	Central to gaining market access & premiums	Limited direct role in finance	Benchmark for advisory and training programmes	Useful in standard-setting and benchmarking
	Socioeconomic data (income, labour, household)	May support compliance with labour, minimum wage or workers’ rights laws; sometimes required in social/labour law reporting	Indirect role only; links the demographic profile to farm records	Assesses risks of poverty, child labour, and forced labour	Central for living income, decent work, and social sustainability metrics; provides demographic insights for Sustainable Development Goal (SDG) indicators	Required in social/ labour certifications	Important for microfinance, livelihood programmes	Informs training & social support services	Used in poverty reduction & development policy; critical in development policy & social programmes
Trade	Transaction/ supply data (sales, volumes, buyers)	Sometimes required for tax or trade compliance	Core to verifying supply chain flows	Helps detect leakage, fraud, or overreporting	Less relevant environmentally, but it shows efficiency	Needed for chain of custody certifications	Used in creditworthiness (sales history as a guarantee)	Moderate use for advisory (benchmark prices)	Supports trade & economic policy

1.3 How is data collected from smallholders?

This section highlights how production plot data previously described is most frequently acquired from a technical standpoint, including whether through direct, farmer-facing interactions or via indirect means. In relation to the drivers for such farm data collection, it also touches on the roles of the initial data manager and external specialized service providers, which may both deploy data collectors and support digital ecosystems. This first overview is key to further explore the impacts that farm data collection may have on smallholders (Section 2), the good practices linked to consent obtention at the data acquisition stage (Section 3.1) and what happens during the next stages of the data journey (data management and data sharing, covered in Section 3.2 and Section 3.3). See Figure 3 to learn more how production data is collected.

Figure 3. How production plot data is collected



Source: Authors' own elaboration.

1.3.1. Direct vs indirect data collection means

Most farm-specific data, including geospatial data, are still collected directly from farmers through onsite activities. Traditional survey methods remain widely used to gather farm-specific data. These surveying activities can be supported by dedicated technologies, such as smartphone apps developed for this specific purpose. Geospatial data is still frequently collected using handheld global positioning system (GPS) devices. Drones may also be used onsite to capture the boundaries of a farm or plot (ISEAL, 2025b). Other types of onsite data collection may include focus group discussions, key informant interviews and field observations.

Onsite collection activities are time- and resource-intensive. Human surveyors must be trained and deployed. Scaling up the collection of farm-specific information over a large producing area necessarily relies on a pyramidal network of surveyors and local relays to be able to reach targeted farmers. This is usually done with the support of local and/or village authorities.

Kenya has conducted an initial farmer mapping for its KIAMIS and has been regularly conducting registration exercises. A recent registration drive was conducted in August 2025 and aimed to register an additional 500 000 farmers. To initiate the process, farmers were expected to first present themselves at local registration centres such as county agricultural offices (Kenya News, 2025) (see Section 6.2).

Some farm-specific data may also be generated remotely or indirectly, without direct interaction with farmers. For instance, geospatial information may be generated remotely by drawing polygons over existing satellite imagery or base maps, and/or by using artificial intelligence specialized in land-use mapping (ISEAL, 2025b). Some data elements may also be inferred from others. For instance, farm boundaries can yield information about farm area or the types of crops cultivated by overlaying the boundaries with relevant satellite imagery or maps.

1.3.2. THE ROLE OF THE INITIAL DATA MANAGER AND SERVICE PROVIDERS

The initial data manager is usually a large actor responsible for the decision to launch a farm-level data collection initiative. This can be a government that deploys nationwide farmer mapping initiatives. When the private sector leads data collection, this is usually the first large economic actor to purchase or process the agricultural or forestry commodity (it can be a mill, a trader, an exporter, etc.). Smaller actors, such as farmers' groups, can also sometimes lead data collection efforts themselves, especially in the context of voluntary or mandated certification.

Initial data managers, however, do not work in isolation; in the context of due diligence drivers, they usually receive data requests from buyers, authorities or other stakeholders, which prompt the data collection initiatives. They may also pass on data collection efforts to upstream actors, such as small traders and aggregators. Initial data managers, however, are those likely to incur the direct costs of data collection and who will have privileges and strong legal rights to the data and digital systems that hold it.

Initial data managers may centralize all the data collection functions, which imply developing in-house digital systems and relying on in-house surveyors. In practice, most data managers rely on some form of external support to set-up and deploy a digital system and/or to populate it with data. This can take many different configurations.

Data collectors, particularly field surveyors, are usually deployed to implement data collection activities. They can be:

- directly commissioned by the initial data manager;
- deployed by a specialized service provider for this specific task; or
- upstream traders, aggregators, or farmers' cooperatives tasked with additional data collection missions.

Underlying digital systems ("digital ecosystems") are also key to the development of a large data collection exercise. Such systems can be one or a combination of the following options:

- developed in-house by the initial data manager;
- offered by a specialized digital service provider for a fee; and/or
- made available freely as part of DPI or open-source solutions (see Section 4.3 for more details).

In Côte d'Ivoire's rubber sector, mills were already regularly visiting farmers in nearby supply bases for agronomic support and have added plot boundary mapping as part of their dedicated tasks. The mill, SOCFIN, has also developed its own digital systems in-house to collect and store relevant smallholder data (Preferred by Nature, personal communication, 2023).

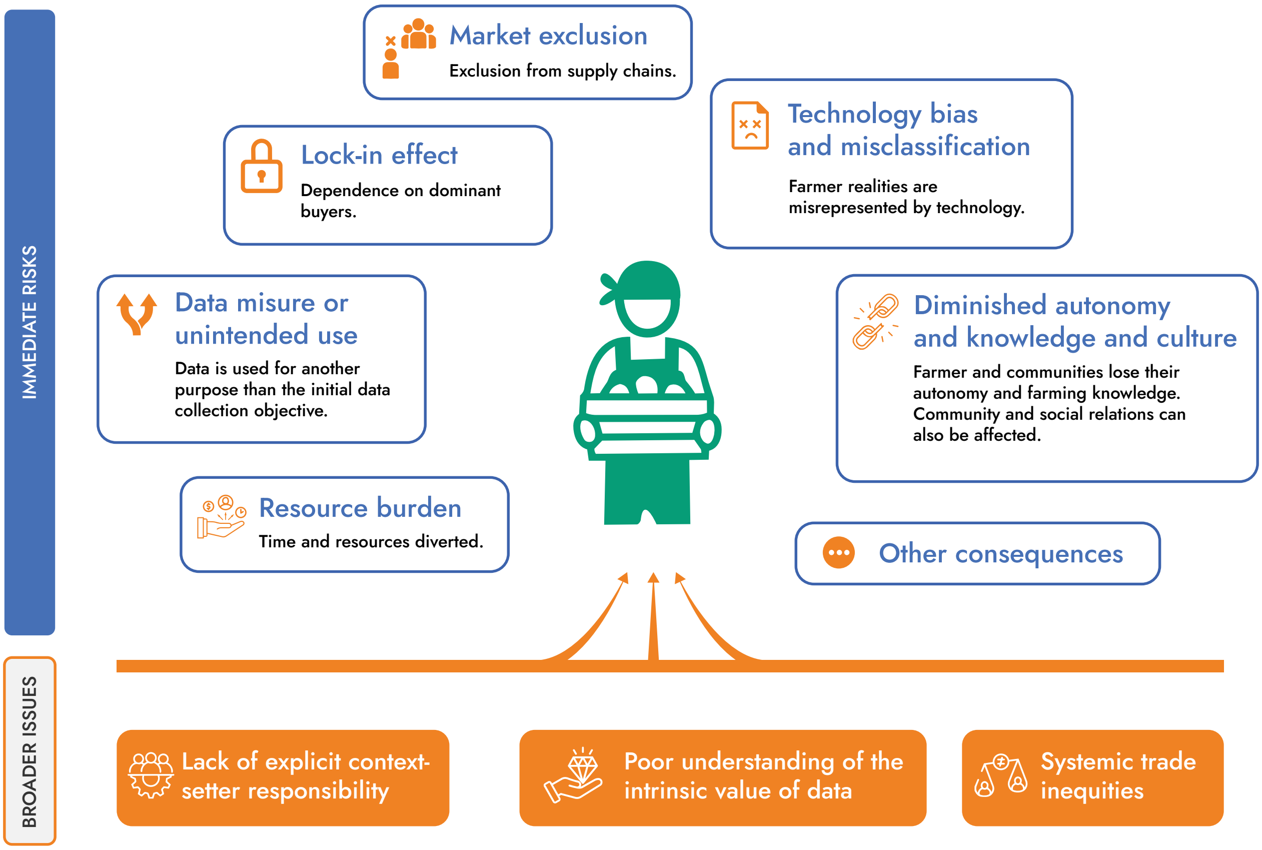
In practice, many actors launching extensive supply base mapping and farm data collection rely on external, specialized actors (such as Koltiva, Satelligence, Sourcemap, Agridence, Farmforce). Those providers usually offer both the underlying digital infrastructure to deploy farm data collection (field apps running on smartphones, databases, user interfaces, etc.), as well as teams of specialized surveyors ("boots on the ground").

2. Risks and inequities bearing on smallholder farmers

Production plot data collection, highlighted in the previous section, has rapidly expanded and developed over the past decade. As it is implemented to an end (such as to reduce deforestation or child labour), it has not been sufficiently considered as a topic that needs to be framed and discussed in this way. Discourses are often framed as technical challenges needing technical solutions, with little room for ethical and legal considerations. The lack of central supervision of smallholders' data collection in the context of agricultural and forestry supply chains does not encourage actors to adopt a more holistic approach; instead, they focus on what is most efficient and least resource-intensive for their own interests. Due diligence regulations have even exacerbated the lack of careful consideration around farm data collection, with a relatively tight deadline for downstream actors to comply, prompting a race to get polygon and legality data.

There are, however, several potential unintended negative effects for smallholders embedded in broader systemic power imbalance within global supply chains. Drawing on literature and case study findings, this section provides a structured overview of the main risks and inequities associated with the collection and use of smallholder data. Section 2.1 describes immediate risks while Section 2.2 expands towards broader issues of fairness and equity. Figure 4 highlights the risks and inequities related to smallholder data collection and use.

Figure 4. Risks and inequities related to smallholder data collection and use


IMMEDIATE RISKS
Market exclusion
Exclusion from supply chains.
Lock-in effect
Dependence on dominant buyers.
Technology bias and misclassification
Farmer realities are misrepresented by technology.
Data misure or unintended use
Data is used for another purpose than the initial data collection objective.
Diminished autonomy and knowledge and culture
Farmer and communities lose their autonomy and farming knowledge. Community and social relations can also be affected.
Resource burden
Time and resources diverted.
Other consequences
BROADER ISSUES
Lack of explicit context-setter responsibility
Poor understanding of the intrinsic value of data
Systemic trade inequities

Source: Authors' own elaboration.

2.1. MAIN RISKS ASSOCIATED WITH THE COLLECTION AND GOVERNANCE OF SMALLHOLDER DATA

Immediate risks faced by smallholders are structured in the following subsections; while this list may not be fully comprehensive, it aims to cover the most relevant risks currently identified from the research carried out for this study. Most of those following risks are further exacerbated by the overall low digital literacy and access to digital systems from smallholders (FIAN International, 2020).

2.1.1. ADDITIONAL FINANCIAL AND RESOURCE BURDEN

Most of the time, farmers are directly involved in collecting their farm data: they know their own plot boundaries and will need to physically accompany surveyors to delineate their farm, and they know the answers to the questions the surveyors need to fill out. Meeting those requests may divert time and resources from other farming activities, in a context where farmers are struggling with low incomes and economic insecurity (ISEAL, 2025b). Farmers may also be surveyed on multiple occasions, as several private-sector and government-led mapping activities coexist.

Where relevant, producers' groups, such as cooperatives, also face an increased burden as they may be required to support the data collection effort and manage the collected data, often without much additional resources to implement this new mission.

Aside from structural changes in economic models and price distribution, alleviating the financial and resource burden on smallholders may rely on stronger data interoperability, the use of DPI (Section 4.3), and the active participation of smallholders in system design and implementation.

2.1.2. DATA MISUSE OR UNINTENDED USE

Different types of data carry different levels of sensitivity and risk, depending on how they are collected, used, and shared (FAO, 2021a). Geospatial and related plot data can potentially lead to data use not initially intended or agreed to by farmers.

Examples include:

- Increasing taxes weighing on farmers has been a key concern for farmers and a strong disincentive to participate in land title formalization and farmers' registries. Government authorities could indeed use the collected data to levy additional taxes on farmers, especially in informal contexts where tax regulations exist but have not been applied in the agricultural sector (see Section 6.1).
- Specific land location can also lead to land dispossession, especially in contexts of weak tenure protections (van Noordwijk *et al.*, 2025), or in contexts where crop production has developed in protected or forested areas not legally designated for agricultural purposes.
- Farm production data, including yield and productivity levels, can lead to price manipulation, exclusion from support programmes, or justification of unfavourable contract terms (Fairbairn, 2023; Atik and Martens, 2021).
- Personal identifiers can lead to identity theft, surveillance, and loss of privacy (UNICEF, 2021).
- Livelihood vulnerabilities or sensitive social risks, such as child labour, can also lead to financial and service exclusion, marginalization through profiling, and unintended harm from poorly designed interventions (UNICEF, 2021).

Limiting data misuse or unintended use is attainable through appropriate consent-obtaining practices (Section 3.1), as well as through a much stronger involvement of farmers in defining the rules and processes for data collection and use.

2.1.3. LOCK-IN EFFECT

Farm data collection can also lead to a disproportionate lock-in effect, in which farmers become increasingly dependent on dominant buyers and digital platforms (FAO, 2021a). Farmers can be locked into long-term relationships with buyers and face reduced autonomy in choosing who to sell their product to. While many different factors induce such a situation, data collection initiatives and associated technology investments may contribute.

Dependency and lock-in risks evolving from data collection processes include (Prism, 2025; WEF, 2024; Hackfort, 2023):

- Farmers are becoming dependent on a specific provider's technology and platform to access and use their own farm data. If they switch, they may lose access to their historical data or find it in a format incompatible with a competitor's system (lack of interoperability).
- Barriers to switching the crop grown on a farm may arise, as farm data collected remains very sector-specific and sits in silos; farmers may lose some freedom to determine which crop to grow on their farm if there is an additional cost to redo a data collection exercise and/or switch to different data systems.
- Farmers' ability to sell to a premium market may become contingent on their continued data contribution and compliance with algorithmic recommendations from a specific platform. Changing providers means losing this crucial track record and market access. A data collector's comprehensive knowledge of a farmer's operation can create vulnerability, potentially exposing farmers to unfair competition or enabling other actors (such as buyers or lenders) to manipulate pricing and risk assessment against the farmer's interest.
- Buyers who invest in field mapping efforts and associated software and database development are incentivized to create an economically viable investment through securing supply from a producing area in the long term and preventing competitors from benefiting through data portability.

Such lock-in risks may also be better controlled by considering farmers' perspectives in the definition of rules and processes for data collection and use.

2.1.4. Market exclusion

Smallholders who lack the means, willingness or knowledge to meet digital compliance requirements face exclusion from export markets. As the United Nations Development Programme (UNDP) notes, "if traceability tools are not designed with inclusion in mind, they can easily become new or reinforce existing barriers to equitable and sustainable trade" (UNDP, 2025).

Failure to generate or report plot-level data may result in losing access to the European Union market, forcing farmers to sell lower-value, nontraceable commodities. This exclusion harms livelihoods and shifts deforestation to less-regulated supply chains, creating strong pressure to consent to data requests.

Although compliance obligations typically target traders and processors, the burden of data provision often falls on farmers. With limited capacity to negotiate data terms, smallholders face market access conditions that effectively redefine their data rights – not only through law but also through commercial pressures.

Exclusion consequences are strongly linked to the lack of explicit responsibility of context setters requiring farm data for sustainability objectives (for example, regulated market authorities such as the European Union) (Section 2.2). Addressing those could partially rely on the implementation of effective grievance and redress mechanisms (Section 4.3).

2.1.5. Technology bias and misclassification

Digital systems, such as data collection tools or machine learning algorithms, frequently misrepresent the realities faced by smallholders. Standardized data collection tools may push generic data or information requests to farmers – directly or indirectly via downstream actors, without considering whether these requests have any meaningful or practical basis. Some compliance tools, for example, request generic evidence of compliance with requirements on FPIC by local communities, even when such requirements may not apply in a given local context. Failure to obtain evidence may ultimately result in a flagged compliance risk.

The reliance on algorithmic decision-making may also pose risks, as farmers may be affected by automated outcomes (FAO, 2021a), such as in carbon credit schemes (Kaur *et al.*, 2022) or in a compliance context. Remote sensing algorithms, for example, can misclassify agroforestry systems as forest, unjustly indicating deforestation risks (van Noordwijk *et al.*, 2025). Scenario analyses warn that unchecked algorithmic bias could deepen smallholder marginalization (Prism, 2025).

It is key that farmers have the appropriate right to access their farm data in the system storing it, with the ability to modify it if incorrect (Section 3.2). The implementation of appropriate grievance and redress mechanisms (Section 4.3) can also be a key solution, together with an overall stronger implication of farmers in the design of digital systems and data collection practices.

2.1.6. DIMINISHED AUTONOMY OF FARMERS AND COMMUNITIES, KNOWLEDGE AND CULTURE

Research also indicates that emergent data-intensive technologies have the potential to diminish farmers' autonomy and augment corporate influence over decision-making processes in agriculture (Rose *et al.*, 2023; FAO, 2021a).

Corporate-led digital platforms can promote standardized practices that may undermine local farming systems. In some contexts, digital service programmes offering financial access to smallholders have required farmers to adopt prescribed production methods, such as discouraging intercropping – for instance, advising against planting beans alongside maize. These requirements can displace agroecological knowledge and reduce on-farm biodiversity in exchange for access to digitized services (GRAIN, 2021). Such forms of standardization may, in turn, affect farmer autonomy and erode cultural heritage.

Treating farmers as individual data subjects may also have social and cultural implications (FAO, 2021a). A farmer's polygon can potentially reveal information about neighbouring communities, thereby broadening the scope of exposure beyond the individual to the collective. Moreover, plots and resources are often managed collectively, a complexity potentially not captured by digital data collection systems. As Vijoen (2021) emphasizes, "individualist data-subject rights cannot represent, let alone address, these population-level effects". Relational theories suggest that data should be seen as embedded within social relations rather than just as an asset, thus supporting collective governance and group rights considerations (Viljoen, 2021; Taylor, 2017).

Farmer-centric rule setting and process definition for data collection may address these challenges – in particular, the implementation of collective data governance models at the producers' level.

2.2. BEYOND IMMEDIATE RISKS: BROADER ISSUES OF FAIRNESS AND EQUITY

Apart from the rather immediate and concrete risks previously described, data governance should also address broader issues related to the responsibility and accountability of rule setters, as well as profit sharing and equity embedded in the trade of agricultural and forestry commodities.

2.2.1. LACK OF EXPLICIT CONTEXT-SETTER RESPONSIBILITIES

The highlighted risks are not standalone – they are rooted first and foremost in the responsibility of the "context setters": those who define the rules of the system (Platformable, 2025). Whether these rules are set by governments (such as Brazil, Ghana and Indonesia), voluntary systems (such as RSPO and FSC), or corporate actors (Cargil Triple S), they shape expectations, power dynamics, and limitations (or lack thereof) for all downstream data interactions.

Despite their central role, the governance responsibilities of context setters are rarely formalized. A review of frameworks developed by ISEAL (2020b), FAO (2021a), and Fripp *et al.* (2023) confirms that while many emphasize high-level principles like transparency, accountability, and participation, very few explicitly define the responsibilities of those who create or impose data requirements – particularly regarding fairness, proportionality, or safeguards against overreach.

For example, the European Union Code of Conduct recognizes the role of data originators but does not prescribe clear responsibilities for standard setters or governments who compel data collection (European Union Code of Conduct, 2018). Similarly, the United Kingdom's Food Data Trust Framework (UK FSA, 2023) outlines stewardship responsibilities but is primarily focused on data holders and users rather than the rules imposed by context setters. This leaves a gap in accountability, particularly for systems where data collection is mandated as a condition of participation or compliance.

Few certification systems or legal regimes provide explicit policy guidance on what entities can or cannot collect on behalf of the system, or how those entities should act with respect to responsibility, security and consent. The RSPO Certification System requires certification bodies to maintain and disclose a documented confidentiality policy to their clients, addressing how sensitive information is handled (such as financial data and supplier details) (RSPO, 2020).

2.2.2. LACK OF COMMON UNDERSTANDING ABOUT THE INTRINSIC VALUE OF DATA

Datafication – the transformation of human activity into digital data – has become central to both the digital economy and environmental governance (Couldry and Mejías, 2020). However, because data is intangible, it is not easy to perceive its value, unlike physical objects that can be traded. Yet, even if not always directly monetized, data has intrinsic value, including in the agricultural sector, where it has been coined as a "new cash crop".

Plot-level data now supports sustainability claims, traceability, financial scoring, and carbon markets, yet smallholders often receive no compensation for providing the relevant information (USAID, 2023). This reflects a broader tension between value extraction and benefit-sharing, where agribusinesses profit from farm data while farmers are excluded from the gains (USAID, 2023). As Sidi Amar (FSD Fair & Smart Data, 2023) puts it, farmers become "unpaid data harvesters for multinational corporations".

The imbalance extends beyond economics to cultural and epistemic exclusion. Agritech firms, traders, and state agencies can analyse vast datasets, while smallholders lack such capacity (Jouanjean *et al.*, 2020). Civil society groups from the Global South describe this as data colonialism – echoing historical extractive practices. Critics argue agrifood data systems "reproduce elements of 'data colonialism' with little regard for collective harm" (Fairbairn *et al.*, 2023); Iyer (2022) likens current practices to colonial resource exploitation under the term "digital extractivism".

2.2.3. SYSTEMIC TRADE INEQUITIES

This imbalance – farmers bearing the risks associated with providing sensitive farm-level data, while powerful actors extract and capture value from it – reflects broader, long-standing power structures in agricultural commodity chains, which is highlighted by a political economy perspective.

Indeed, smallholders are responsible for producing a vast share of agricultural and forestry commodities.

Examples and figures include:

- approximately 60 percent of global coffee is from farms less than 5 hectares in size and over 50 percent of the world's oil palm is from smallholders (ICO and IISD, 2022);
- in the sectors of soy and grains, only six traders manage approximately 70–80 percent of global trade (Wion *et al.*, 2024); and
- in palm oil, three entities own more than half of Indonesia's refinery capacity, with ten groups controlling over 75 percent of export (Trase, 2020).

A small number of multinational traders and processors dominate global markets for agricultural commodities, meaning that those multinationals, along with state agencies and digital agriculture (AgTech) providers, "increasingly hold unprecedented control over farmer data", reinforcing asymmetries of power between farmers and global technology firms (USAID, 2023; Wion *et al.*, 2024; Trase, 2020; ICO and IISD, 2022).

This consolidation means smallholders – despite their critical role in production – have minimal bargaining power over how their data is used or how benefits are distributed (USAID, 2023).

This is further exacerbated by weak farmers' organizations and cooperatives, which otherwise provide collective bargaining power. Existing data codes of conduct were predominantly created by industry stakeholders rather than by farmers. Without robust representation, smallholders often remain passive participants rather than active rights holders.

This framing highlights that inequitable data practices are not simply technical issues but are embedded in long-standing global inequities. Consequently, there exists a considerable risk that digitalization may indeed redirect power and profits away from farmers (USAID, 2023).

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3. Farm data governance practices and their limitations

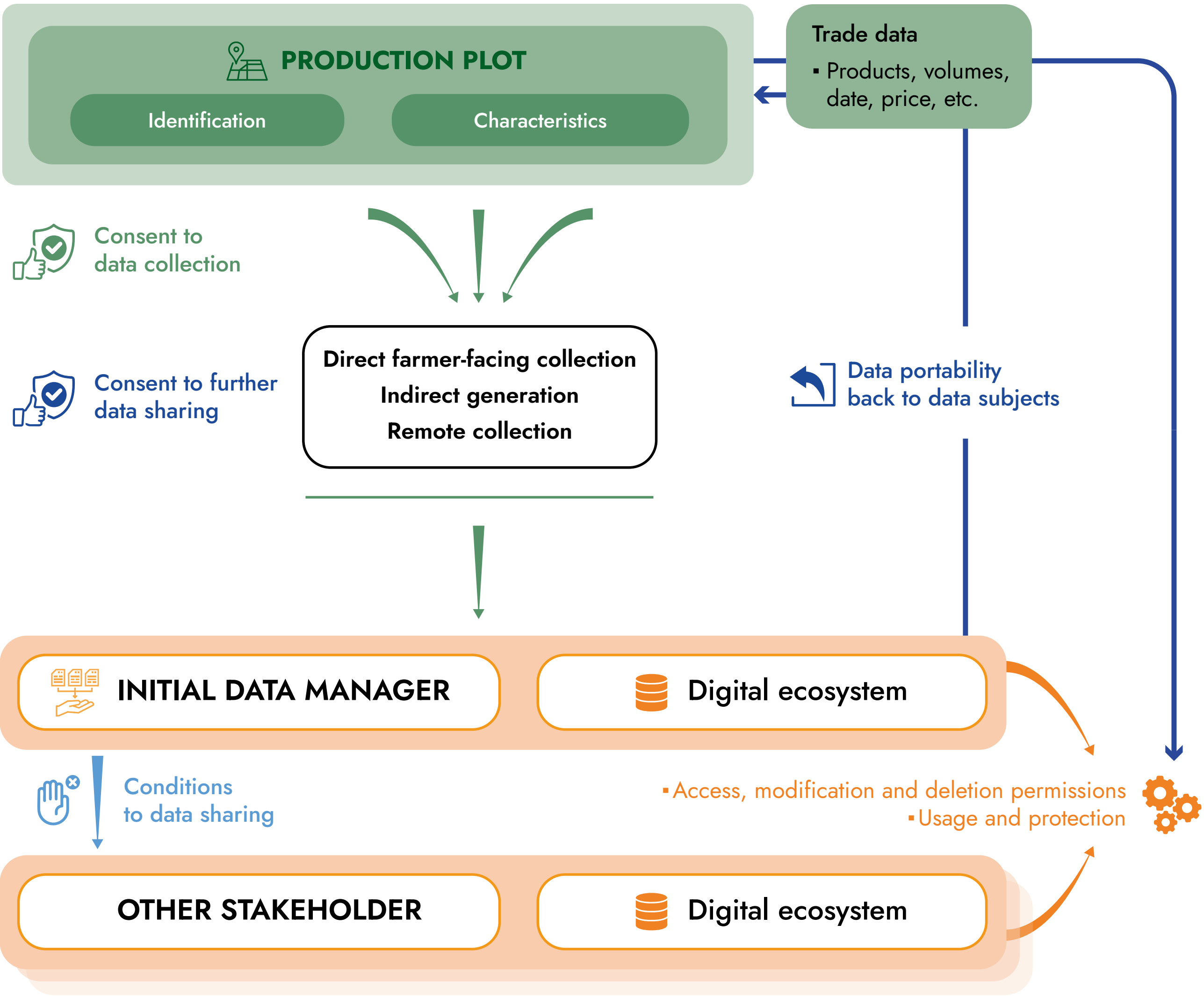
The previous sections described what data is being collected from smallholders (as well as why, how and by whom), and the potential unintended negative consequences that the collection and use of this data may have – in other words, why it is important to uphold better data practices that would effectively safeguard smallholders' interests.

Several concepts, such as data governance, data rights or data ownership are put forward to frame the discussion. While those are very important, they also tend to remain relatively abstract, and without a clear consensus on their definition. This section therefore starts by exploring the concrete steps of the farm data life cycle to summarize the state of play and emerging good practices for each tangible step. The next section (Section 4) builds on these concrete practices to elaborate on the overarching approaches that would facilitate their uptake and impact.

Section 3.1 describes the beginning of the data life cycle, the initial data collection, and associated consent practices. Section 3.2 follows with the different access and use practices once data is collected and stored in a system. Section 3.3 then explores practices around data sharing to further systems and across the full life cycle.

Figure 5 highlights the different steps of the data journey and where elements of consent, data management and data sharing are relevant.

Figure 5. Key data governance practices in the data life cycle


PRODUCTION PLOT
Identification
Characteristics
Trade data
▪ Products, volumes, date, price, etc.
Consent to data collection
Consent to further data sharing
Direct farmer-facing collection
Indirect generation
Remote collection
Data portability back to data subjects
INITIAL DATA MANAGER
Digital ecosystem
Conditions to data sharing
▪ Access, modification and deletion permissions
▪ Usage and protection
OTHER STAKEHOLDER
Digital ecosystem

Source: Authors' own elaboration.

3.1. CONSENT OBTENTION AT DATA COLLECTION STAGE

State of play

As highlighted in previous sections, smallholders' farm data collection is still typically conducted through farmer-facing field activities, with some exceptions (Section 1.3). At this stage, practices for securing explicit farmers' consent for data collection are increasingly being considered and implemented. However, challenges lie in the extent to which consent is freely obtained and well-informed.

Indeed, consent is often buried in onboarding forms, bundled into membership agreements, or delivered verbally by field agents. Forms may be in official languages, not local dialects.

Consent may also be implicit or coerced, where accessing services, certifications, or markets implies acceptance of all associated data practices, regardless of whether farmers fully understand or agree to them (USAID, 2023; Chichaibelu *et al.*, 2023). The tension between consent and programme or market access can render consent nominal rather than meaningful, as refusals may, in practice, result in exclusion from those programmes or markets.

Consent may also be obtained without a clear explanation or understanding from the farmers of the purpose of the data collection. As reported by Germanwatch, farmers are often unaware of the fate of their data after collection (Brandt *et al.*, 2024). It is not uncommon for this data to be gathered by traders and then transferred to third parties (such as fertilizer companies) without the knowledge of concerned smallholders. Interviews with agricultural groups have revealed that once collected, farmer data is often sold to third parties without the farmers' consent for this additional use.

Consent may also not be present at all, for instance, when generating plot data indirectly using maps and satellite data.

In Viet Nam, due to the multilayered structure of rubber sourcing and the reliance on local collectors or agents, farmer data collection often occurs informally, without appropriate consent. The collectors or agents may lack the expertise and incentive to secure appropriate consent (see Section 6.3).

In Côte d'Ivoire, cocoa cooperatives collect data from smallholders using digital tools provided by exporters or certification bodies. While farmers may sign paper forms that include consent clauses, there is often no opportunity to ask questions or opt out of specific data uses. Once collected, data is uploaded to platforms managed by external actors, and farmers are not informed if or how their data is being reused for analytics, compliance reports, or commercial insights (Preferred by Nature, personal communication, 2025).

In Ghana, farmers' participation in the Cocoa Management System data collection (EFI, 2024) is linked to access to services such as fertilizers or price premiums, effectively making consent a condition for market participation (EFI, 2024).

This topic also raises the issue of individual consent versus collective rights. Indeed, data pertaining to land plots is fundamentally relational: the polygon of one farmer may disclose information about neighbouring farmers and entire landscapes. However, governance frameworks continue to prioritize individual consent, thereby neglecting potential collective harms (Viljoen, 2021; FNIGC, 2025).

Frameworks such as the OCAP Principles and the CARE Principles[11] emphasize collective governance and stress that Indigenous Peoples' rights and interests in data derive from their inherent right to govern their peoples, lands, and resources (Carroll *et al.*, 2020).

Applying this logic to agriculture means that farmer cooperatives, producer organizations, or rural communities must have a voice in governing how plot-level data relative to the community is used and redistributed, even if management and use rights can be linked to individual farmers. The United States Agency for International Development (USAID) Digital Farmer Profiles report emphasizes that "farmer organisations can play a central role in ensuring farmers retain agency in how their data is shared" (USAID, 2018). Evidence from FAO (2021a) and Jouanjean (2020) also emphasizes that, in the absence of trustworthy intermediaries, individual farmers are unable to exercise their rights effectively.

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[11] The OCAP Principles refer to the Ownership, Control, Access and Possession Principles; the CARE Principles refer to the Collective benefit, Authority to control, Responsibility, and Ethics Principles.

Fairtrade International has piloted cooperative-led data models in Kenya to empower farmers to the use of traceability data, thereby ensuring that benefits are redistributed to producers rather than being appropriated solely by buyers or platforms. These instances illustrate data sovereignty as a collective right, rooted in participation, negotiation, and the redistribution of power.

Existing initiatives based on collective rights and representation in farm data systems are facing several limitations: most rely on donor support, remain limited in scale, and lack robust regulatory enforcement, thereby raising concerns regarding their long-term viability (USAID, 2023; Jouanjean, 2020).

Risks associated with a lack of robust and appropriate consent practices range from data misuse or unintended use, market exclusion and diminished farmers' autonomy and knowledge (highlighted in Section 2).

Emerging good practices

There is a tremendous wealth of resources exploring and outlining appropriate consent processes, whether in different contexts (research, health information, Indigenous Peoples' rights, technology and digital services, etc.) or in the agricultural context specifically (FAO, 2021a; GODAN, 2020; Kaur *et al.*, 2022; IFAD, 2021; Kenya Office of the Data Protection Commissioner, n.d.; United Kingdom Information Commissioner's Office, n.d.).

Good practices align with the following principles:

- Consent must be freely obtained: the data subject should have a genuine choice to provide their data or not. If an individual has no choice, consent is not voluntary and can be considered invalid. This means that individuals should be able to refuse consent without detriment. Obtaining consent can be incentivized with a reward; however, the threshold to actually penalizing those who refuse consent is quite thin and must be carefully considered:
    - Further, consent should also not be a condition for the provision of a service unless necessary for the rendering of the service in question. For instance, if a farmer chooses a certification system that requires geolocation mapping, consent to provide the farm's geospatial data could be bundled with the general provision for certification services. On the contrary, geospatial data cannot be requested as a condition for the provision of financial services that do not rely on this data.
- Consent must be specific and informed: the data subject must understand clearly who is collecting the data, what data is being collected, for what purpose, how it will be stored, who will access it, and how long it will be retained (FAO, 2021a). If data is collected for multiple purposes, consent can be broken down into granular options, allowing the data subject to agree to some uses but not others. In the context of due diligence regulations, geospatial and farm data collection should clearly indicate which information will be shared across the supply chain and with which actors, for instance, with all buyers and up to the European Union information system for EUDR compliance:
    - Consent requests should not be vague. It is good practice to use the local language spoken by farmers, as well as familiar means of communication, such as verbal exchange and the support of local figures of authority. It is also good practice to hand out a simple, concise data collection written notices, so that the data subject can keep a record of what they have consented to.
    - Should the data collector want to use the collected data for a new, unforeseen objective, a new consent must be obtained from the data subject. Geospatial and farm data initially collected for due diligence purposes should not be sold or transferred to pesticide firms, financial institutions or agricultural extension providers, if not specifically consented to.
    - Some organizations are adopting flexible, realistic, yet careful approaches to using and sharing data for new purposes: for instance, the West Africa Cocoa Dataset of the World Resources Institute (WRI) was established by aggregating cocoa production plot information from 19 companies. Consent was not sought again for the 1.2 million polygons submitted; however, the final product is distributed to the general public as a heatmap of cocoa land use, without precise boundary information. Precise plot boundary information may be shared on a case-by-case basis by WRI for very specific uses that are not expected to impact farmers (for instance, research purposes, algorithms and model development) (Preferred by Nature, personal communication, 2025). Guidance from the University of Illinois emphasizes modular informed consent to accommodate future reuse without onerous re-consent procedures; the concept of social license encourages ongoing community trust beyond traditional consent mechanisms (University of Illinois, 2022; Nathler, 2023).

- Consent must be explicit and recorded: consent should involve an unambiguous agreement through a clear statement or action: for instance, a signature or box ticking. In the context of due diligence, it is important that initial data managers can later demonstrate that they have indeed obtained consent to the data collection.
- Consent must be revocable: the data subject should have the right to withdraw consent at any time, which also entails the means to do so. Withdrawal processes should be easily available to data subjects:
    - There are obvious limitations to revoking consent when data has been extensively shared with other actors, especially if this sharing has not been properly tracked.

There are significant costs and resource implications to obtaining thorough, robust consent from large pools of farmers following the previously mentioned principles to the letter. Most actors will need to balance practicalities with thoroughness and do as much as possible in each context. There are inherent limitations to free consent in the context of global agribusiness supply chains, where farmers must adhere to certain systems to be able to sell their production. Consent to data collection is not a silver bullet and must be accompanied by the inclusion of farmers in data system design and by other structural changes. Yet, the previously mentioned principles and examples of successful, practical implementation in the context of due diligence are good practice to be shared and replicated.

In Colombia, the National Federation of Cocoa Farmers (Fedecacao) upholds the national data protection law by issuing data privacy rights notices to farmers and requiring them to sign a written consent form before collecting their data (see Section 6.1).

In Kenya, the KIAMIS Data Governance Framework includes a data subject consent form (Appendix M) and a data protection consent form guiding interviewers (Appendix Y). The information is intended to be read out loud to the respondent in the language they are most familiar with. Enumerators must also provide a copy of the data protection consent form if requested by respondents, via WhatsApp, email or other convenient means (Kenya Ministry of Agriculture and Livestock Development, 2024) (see Section 6.2).

Koltiva has developed a data collection process, designed to be aligned with the GDPR and local legislation (Preferred by Nature, personal communication, 2025). It first involves community outreach and socialization sessions to inform farmers about the process and its purpose.

During the collection exercise, farmers are provided with written consent forms and clear explanations of which parties, such as refineries and palm oil mills, will have access to their data. Consent is collected by field agents based on a pre-written script, which can be delivered in the local language (such as Bahasa). Farmers usually sign with their finger.

The data collection form also allows farmers to provide differentiated consent: for instance, they can agree that the farm is surveyed but disagree to share their land certificate (see Section 6.4).

The United Kingdom Food Data Trust Framework offers a model of shared data stewardship that formalizes consent, includes time-bound access, mechanisms for revocation, and transparency dashboards (UK FSA, 2023).

ISEAL (2020b) provides clear guidance on setting up and implementing a consent policy, including covering non-personal data under consent practices, structuring consent processes in a robust manner, using appropriate language and designing alerts in systems when data is likely to be used for another purpose. It offers different options for implementation and recognizes that consent can have limitations and requires “innovation and learning to come to acceptable solutions”.

3.2. Data management after initial data collection

State of play – access, modification and deletion permissions

When information is collected and stored in a digital system, managing permissions to access, modify, and delete the data is essential.

In digital lingo, it is common to refer to those concrete permissions as rights (such as access rights, editing rights and deletion rights). To avoid any potential confusion about rights stemming from the law, this section will refer to permissions – the abilities conferred by digital systems to users, regardless of the legal framework in place (see Section 4.1 for more details on the use of the expression, data rights).

Data managers usually have de facto great latitude to determine who can access, edit and delete the collected data. Permissions are usually embedded in the digital solutions themselves and will likely vary on an individual basis or group of individuals (for instance, some staff from the collecting organization may only view the data, while others may view and modify it). When they are used, external digital infrastructure providers also usually retain some access, modification and deletion permissions, mainly for technical reasons.

Further, data managers can decide to grant data access to external stakeholders. This can take many different forms, with varying level of detail (full set of data vs selected, aggregated and/or anonymized data) and with access granted to different types of stakeholders (from a single commercial partner or a selected expert partner for data analysis, to a larger crowd through a registered user base up to the general public).

Key questions include whether data subjects are granted permissions to access their data (and how), as well as whether they can make modifications when it is incorrect, or even request deletion. In this area, practices vary – from a total absence of any permission and access mechanisms, to the ability to view their own data and, more rarely, request modification or deletion. One step further is the ability to retrieve data on their own system, which is covered in the next section on data sharing (Section 3.3).

In Brazil, the existing data protection legislation applies to all entities engaged in processing personal data, and key rights include the right to correct or delete inaccurate data, the right to revoke consent, and the right to be informed about data usage and sharing (see Section 6.5).

Brazil's CAR requires all rural landholders to map and register their property boundaries for environmental monitoring (Jung *et al.*, 2017; WEF, 2024). While the system contributes to land-use transparency, smallholders have limited influence over how their data is shared or reused. Public access to CAR data is available through platforms such as the Sistema Nacional de Cadastro Ambiental Rural [Rural Environmental Registration System] (SICAR), but mechanisms for farmers to challenge inaccuracies or request deletion are limited.

In Indonesia, the Sistem Informasi Perkebunan [Plantation Licensing Information System] (SIP) collects geolocation data on plantations, including smallholder plots, but data governance responsibilities are fragmented between national and provincial levels, and smallholders have limited ability to manage or correct their data (Kami, 2022).

Ghana's Cocoa Management System (CMS) and Côte d'Ivoire's Côte d'Ivoire's Système de Traçabilité du Cacao [National Cocoa Traceability System] (STC) are designed to provide farm-level traceability by assigning unique farmer IDs and collecting detailed information, including GPS points and input use (IDH, 2021; SASI, 2025; WCF, 2024). These systems help countries meet market expectations for traceability, yet smallholders are typically not provided with access to the data once it has been submitted. There are no dashboards or interfaces through which they can review, correct, or withdraw data, and decisions about data access or retention are made without farmer participation.

Risks associated with unfair data permissions include data misuse or unintended use, facing exposure to technology bias or misclassification, and diminished farmers' autonomy and knowledge, highlighted in Section 2.1.

State of play: data usage and protection

Once acquired, data can be used in different ways (see Section 1.2 for more detail on farm data use):

- analysing the absence or presence of recent deforestation activities associated with crop production (by overlaying plot boundaries and related attributes onto maps and satellite imagery);
- analysing the legality of production (by assessing information such as land titles, management and harvest authorizations, lists of pesticides used, lists of farm employees, etc.);
- linking products sold to downstream actors or markets to production plots (through farm or farmer identification and trade data); and
- analysing production trends, needs for programmes or support services, or even needs for financial products or farming inputs (seeds, pesticides, etc.).

Key questions are whether these uses are legitimate, whether they have been properly understood and consented to by farmers (Section 3.1), and whether they may harm smallholders' interests and rights.

Responsibilities also extend to the protection of data, which is often unclear and not explicit. Data protection mechanisms include encryption and secure data storage, among other means. Another important element is whether clearly established notification procedures exist in the event of a breach. If data is unduly accessed or retrieved by an unauthorized third party, will the smallholders concerned by this data be notified (and how)?

There is also a tension between robust security and the ability for smallholders to access their own data, as strong authentication processes may act as a barrier.

RSPO-certified mills use Prisma (formerly PalmTrace) to manage supplier data in a secure environment (RSPO, 2025). However, access is limited to compliance officers and auditors, and producers rarely have visibility into how their data is used.

Similarly, Ghana's CMS is designed with secure architecture, but lacks a published data governance policy that clarifies retention periods or the right to review or delete records (Ministry of Finance Ghana, 2023).

In Kenya, the KIAMIS Governance Framework mandates data security and privacy processes, including security control encompassing both technical and procedural safeguards. Access is strictly limited to authorized personnel through stringent authentication mechanisms and access control. The relevant ICT infrastructure should include encryption protocols, firewalls, intrusion detection systems, and regular security audits to proactively identify and address potential vulnerabilities. KIAMIS datasets and databases are kept at the Ministry's Big Data Centre located at the Kenya Agricultural and Livestock Research Organization (KALRO) head office, which has sufficient server capacity and data recovery systems (Kenya Ministry of Agriculture and Livestock Development, 2024) (see Section 6.2).

Risks associated with the lack of clearly defined data use, secure storage and transfer systems, or breach notification procedures include data misuse, vendor lock-in, and diminished farmers' autonomy (Section 2.1).

Emerging good practices

Front-runner initiatives promote more equitable practices around data permissions, including stronger rights for data subjects (in this case, smallholders) to access, modify, and understand the use of their data. As a minimum, smallholders should have a dedicated, known, and appropriate contact point to request access to their data. ISEAL (2020b) highlights that organizations' data privacy notices can specify how data subjects should contact them.

More generally, organizations managing farm data should clearly:

- define and document roles, responsibilities and permissions around data;
- specify access and use permissions within the organization and for external parties;
- develop a data retention policy;
- ensure robust data protection of the data and have processes in place in the event of a data breach; and
- ensure that personnel interacting with data have received sufficient training on data principles, systems and processes.

Organizations should, therefore, have a clear data policy covering these topics. Many resources and examples exist to guide this process (ISEAL, 2020b; Kenya Ministry of Agriculture and Livestock Development, 2024; GODAN, 2020).

In Indonesia (Aceh, North Sumatra and Riau), Unilever partnered with Meridia to develop the Smallholder Hub Programme, addressing barriers to sustainability certification and the lack of reliable and up-to-date data on smallholder operations, targeting up to 40 000 independent smallholders.

The initiative focuses on collecting granular field-level data through advanced mapping technologies and direct engagement with smallholders. Meridia's data collection methods enable the identification and profiling of thousands of smallholders, creating a database that supports traceability and regulatory compliance.

The programme emphasizes transparent data sharing to strengthen trust between smallholders and supply chain actors. The Smallholder Hub Programme serve as a gateway for smallholders to access productivity and sustainability measures. The aim is for smallholders to be better equipped to improve their livelihoods through training programmes, RSPO certification support, and income diversification strategies available through the programme.

Digital Green's FarmStack in India provides a farmer-facing interface where users can see who has accessed their data and for what purpose.

In Kenya, the KIAMIS Data Governance Framework includes a procedure for complaint handling (Appendix E), a general complaint form (Appendix O), and a form for complaints related to data sharing and dissemination under Section 56 of the Kenya Data Protection Act (Appendix P) (Kenya Ministry of Agriculture and Livestock Development, 2024) (see Section 6.2).

The European Union Code of Conduct on Agricultural Data Sharing proposes that data originators should have the right to access, correct, and control the use of their data, even when collected by third parties (European Union Code of Conduct, 2018). It encourages contracts to define ownership, access, portability, and reuse. However, the code is voluntary, and uptake varies significantly across countries and sectors (van der Burg *et al.,* 2021; Ryan *et al.*, 2024). While some cooperatives and digital platforms have adopted these principles in pilot projects, widespread implementation remains limited.

The United Kingdom Food Data Trust Framework offers an important reference for operationalizing responsible data management (Brewer *et al.*, 2021). It proposes the formal assignment of roles (such as data controllers, processors, and stewards), guidelines for secure storage, and principles for equitable access. It also emphasizes accountability in the event of data breaches or misuse. While these concepts are gaining traction in Europe, their integration into global commodity systems remains at an early stage.

3.3. DATA SHARING

State of play

Data sharing occurs when information is transferred across organizations and supply actors, resulting in copies stored in additional digital systems.[8] Practices governing how organizations other than the initial data manager obtain data vary across use cases and sectors. The costs of acquiring data and its intrinsic value often discourage extensive sharing, although some sustainability systems and emerging regulations do require the transfer of data between supply chain actors.

End-to-end traceability systems may require harvest and transaction data from raw material production to be recorded and passed to downstream actors in the supply chain.

The EUDR requires production plot data to be shared across supply chain actors up to import into the European Union market, making data sharing practices inherent to regulatory alignment.

Farm data, including production plot data, may be shared through relatively low-tech methods and without specific restrictions (such as geospatial files with plot boundaries sent via email attachments). When the initial data manager shares data with third parties without clear restrictions, few technical or legal barriers prevent further copying and redistribution, making it impossible to control who holds the data and how it is used.

It is relatively common practice for private sector organizations to conclude data sharing agreements before exchanging data, including production plot data. Data sharing agreements can frame or restrict some or all of the considerations (Section 3.2) in terms of attribution of access permissions, data usage, data protection and further sharing that the receiving entity commits to abide by.

However, data sharing agreements require legal capacity to draft and enforce, and strong precedents are limited.

A related question is whether data is shared back to data subjects – in other words, whether smallholder farmers can view or retrieve their data (such as downloading a geospatial file of farm boundaries). The concept of data portability refers to the ability to access personal data and reuse it for one's own purposes.

Both sharing to other actors and portability back to the data originator are linked to concept of interoperability, which ensures that different systems and formats can exchange and process data.

Poorly controlled sharing to external parties can result in misuse or unintended use. The absence of portability mechanisms can lead to vendor or buyer lock-in and reduced farmers' autonomy (Section 2.1).

Emerging good practices

Data sharing to external parties must be clearly consented to by smallholders (Section 3.1). If sharing was not part of the initial consent, the organization holding the data should seek consent for that specific purpose.

To prevent use outside the scope of provided consent, data sharing agreements must be in place. These agreements restrict how the receiving entity may use the data. Without such agreements, it is impossible to ensure that data is not used for unintended purposes that may harm the producer's interests.

Data sharing agreements should pass on the initial collector's commitments, including access restrictions, acceptable use, security measures, and breach protocols (Section 3.2). They should also govern further sharing by the receiving party.

Risks of data misuse can be mitigated through data minimization and deidentification (anonymization or pseudonymization) techniques, ensuring that only necessary information is shared. Agreements should specify exactly which data will be shared – for geospatial data, this includes which attributes are included. For example, to establish the West Africa Cocoa dataset, calibration was required to determine whether plot data referred to polygons without attributes or polygons with core attributes, such as crop type and date of collection (Schneider *et al.*, 2023; Preferred by Nature, personal communication, 2025).

Organizations should maintain records and tracking processes of entities with whom data has been shared. Such records are essential for consent withdrawal (Section 3.1), as well as grievance and redress mechanisms (Section 4.3), especially where data is shared extensively across supply chains. It can be argued that smallholders whose data is shared should be informed, or as a minimum, have access to information about which entities have received their data and whether an appropriate agreement regulates that sharing.

Portability and interoperability are also key principles, enabling smallholders to retrieve and transfer their data across providers, reducing dependency on proprietary technologies or siloed platforms. For smallholders, these principles increase bargaining power, expand access to a wider set of services, and mitigate asymmetries in agricultural data value chains.

To a certain extent, DPI can support more robust sharing practices by encouraging interoperability. It can also facilitate the sharing of anonymized farm data, without associated attributes, such as plot boundaries through GeoIDs (see Section 4.3 for more detail).

In Colombia, the National Federation of Cocoa Farmers (Fedecacao) has collected plot boundaries and farm information for smallholder producers. The intention of the system is to share anonymized data with companies that require it to export to the European Union market. Under national law, data may only be transferred to countries with data protection laws considered equivalent to those of Colombia, and personal data remain accessible to data subjects (Law 1581, 2012) (see Section 6.1).

Koltiva has established a process to facilitate sharing farm data back to data subjects:

- Information shared back is readable and understandable, and is stripped of details that would hinder farmers' use of the data. Data is not shared with farmers in large Microsoft Excel or CSV files.
- Farmers have access to a dashboard, although access requires a smartphone. Koltiva estimates that in Indonesia, only 25 percent of farmers have access to a smartphone, though access within the immediate household increases to around 60 percent. However, this raises questions about whether sensitive or personal data should be accessed through another person's device.
- For more digitally literate farmers, farm boundaries can be exported as a JSON file through the web version of the farmer dashboard.

Koltiva field agents can also print a PDF version of each farm profile. Additionally, relevant information is sent to farmers by SMS, such as transaction details or agronomic advice.

The European Union Code of Conduct (2018) on agricultural data sharing through contractual agreements defines portability as a contractual right of data originators.

FAO (2021a) underlines that portability is only meaningful if data is standardized and machine-readable.

USAID (2023) highlights the role of neutral data stewards and user-centric governance models in making these principles practically enforceable.

ISEAL (2020b) offers clear guidance on data sharing options and how to structure data sharing agreements, including those involving personal or sensitive data. It also provides a data sharing agreement template (Annex 2). ISEAL (2020b) emphasizes that data sharing agreements should clearly assign responsibilities for communication with data subjects and set out the mechanisms available to them.

4. Overarching approaches to strengthen smallholder data governance

Section 3 examined the specific practices associated with the data life cycle, describing the state of play and emerging good practices on consent, rights of data subjects, data protection, rules for data sharing, portability, and interoperability, including in the context of DPI.

This section identifies three main leverages to comprehensively enhance the identified good practices at all stages of the data life cycle: fit-for-purpose regulatory frameworks, voluntary commitments from concerned actors, and the development of an adequate DPI. Those three entry points are not exclusive solutions; rather, they should be considered as a smart mix required to achieve a stronger governance of smallholders' farm data.

Before diving into the details of those leverages, a couple of conditions must be highlighted as conditions for success. Regardless of the entry point harnessed, it is very important to: improve the clarity and alignment on terms, definitions, and concepts used; adopt a farmer-centric, inclusive approach; and ensure increased digital and data literacy of stakeholdersand – first and foremost – smallholders.

Indeed, to collectively implement more coherent farm data practices in a globally fragmented environment, it is important to agree on language and terminology. Concerted efforts to align on terms and concepts can help, along with practitioners being precise in how they use terms and transparency about underlying assumptions. Whether in relevant forums or while actually developing systems, it is important that practitioners clearly frame which stage of the data life cycle is being considered, and whether conditions applied to the use of data is coming from legal, technical, or ethical considerations.

It is clear that upholding and protecting smallholders' interests greatly depends on genuinely incorporating their own perspectives, and ideally their direct participation in system design, which remains too rarely the case. The context setters (see Section 2.2.1) – whether those who enact regulatory frameworks or those who build systems using smallholder farm data (certification systems, traceability systems, national management systems, etc.) – have a primary responsibility to design requirements and develop systems that are farmer-centric, meaning they explicitly incorporate farmers' perspectives and interests.

USAID (2023) highlights that "empowering (smallholder) farmers with more control over their data is critical to improving and protecting their livelihoods", while also supporting "a user-centric approach to data governance that places farmers and their communities at the centre of data gathering initiatives and aims to reduce the negative effects of centralised power".

Beyond being consulted, smallholders can be involved directly in the design of systems that use their data. Smallholders and their representatives are indeed rarely involved in setting data governance rules, thereby reducing the legitimacy and responsiveness of systems. Encouragingly, several pilot projects, frameworks, and public–private partnerships are beginning to chart a path toward more inclusive, transparent, and equitable data governance in global agricultural supply chains by embedding participatory mechanisms into system design and implementation.

The Maastricht University Fair & Smart Data initiative places smallholder participation at the core of data governance (FSD, 2023).

The Global Partnership for Sustainable Development Data promotes participatory data governance mechanisms – such as citizen assemblies, multistakeholder platforms, or data trusts – that actively involve communities in shaping data practices rather than leaving decisions in technocratic hands (GPSDD, 2022).

The Consultative Group on International Agricultural Research (CGIAR) Digital Transformation Accelerator Program, in collaboration with African national agencies, is advancing data governance frameworks that protect smallholder rights and support digital literacy, data security, and equitable access to agri-data platforms – embedded within broader policy environments rather than just technical tools (Ehui *et al.*, 2025).

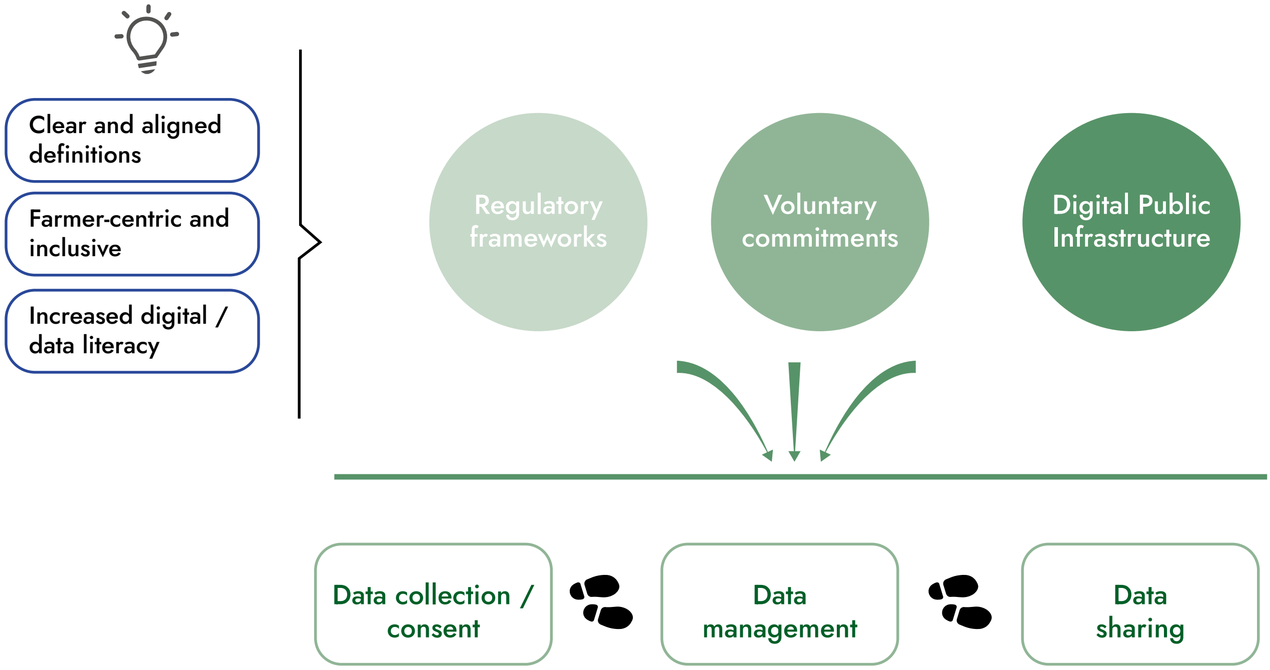
In addition, efforts to design farmer-centric systems can incorporate principles of collective rights over agricultural data, as opposed to systems based on individual farmers.

Inclusive and participatory data system design also requires enhanced digital and data literacy from smallholders. Bridging the digital divide for rural communities implies building appropriate digital skills and ensuring access to infrastructure (such as smartphones) and networks at reasonable costs. Enhanced digital and data literacy is a key pre-condition for smallholders and producer organizations to proactively defend their interests when participating in agricultural data systems.

Should all the identified challenges be addressed through the identified approaches, an emerging dilemma in agricultural data governance is what to do with historical data previously collected when new rules, policies, or purposes emerge – a shift that raises concerns over retroactive use of that data. Even when context setters enact new standards, they often overlook the question of whether previously shared smallholder data remains usable if it does not apply to emerging standards of practice.

Figure 6 highlights how the three leverages discussed can influence practices around data governance and some of the identified conditions for success.

Figure 6. Recommended approaches to strengthen smallholder data governance


Clear and aligned definitions
Farmer-centric and inclusive
Increased digital / data literacy
Regulatory frameworks
Voluntary commitments
Digital Public Infrastructure
Data collection / consent
Data management
Data sharing

Source: Authors' own elaboration.

4.1 VOLUNTARY COMMITMENTS AND EFFORTS

Stakeholders involved in the design and use of data systems can – and should – work collectively to strengthen data governance. This entry point is directed at non-governmental context setters such as agrifood businesses (such as traders, processors and exporters), voluntary scheme owners, supply chain management service providers, or non-governmental DPI initiatives.

Strengthening practices across fragmented sectors, geographies, and use cases indeed requires more systematic sharing of effective approaches and tested models. Sharing failures can also encourage actors to learn from one another.

The OECD–FAO pilot implementation of the Guidance for Responsible Agricultural Supply Chains brings together over 30 companies and initiatives to test how supply chain actors can practically apply due diligence in data governance, including clarifying who bears responsibility for data collection, transparency, and farmer protection (OECD, 2018).

Beyond collective learning and knowledge exchange, other tools and resources can be mobilized to support proactive improvements in data governance. There is already a wealth of such resources, although those are not necessarily specifically focusing on the use case of production plot data collected for sustainability and due diligence systems. Existing resources can be adapted into case-specific tools, making them more actionable and translated into concrete data governance practices for this use case:

- **Governance frameworks** play an important role by enabling transparency, balancing the interests of diverse stakeholders, and safeguarding farmers' rights (IDH, 2023; USAID, 2023). The United Kingdom Food Data Trust Framework is a good example and could be adapted to governing smallholder farm data within sustainability systems. Governance frameworks can also be developed by producing countries, as it has been done in Kenya (Kenya Ministry of Agriculture and Livestock Development, 2022, 2024).
- **Codes of conduct** are useful to list and uphold the minimum good practices that organizations should uphold when collecting and managing smallholders' data. For instance, the European Union Code of Conduct could serve as a basis to develop a case-specific voluntary code of conduct for production plot data sharing in due diligence systems. Kenya's Data Governance Framework also calls for the development of Kenyan Agricultural Codes of Conduct (Kenya Ministry of Agriculture, Livestock, Fisheries and Cooperatives, 2022).[12] While adoption of existing examples is not broad or mature enough, it is estimated that they have a positive impact in building trust, awareness and participation (FAO, 2021a; Sanderson *et al.*, 2018). It is important to bear in mind the imperative of a farmer-centric approach when developing such codes of conduct. Indeed, FAO (2021a) flags that the existing codes of conduct for agricultural data (2018 European Union Code of Conduct, American Farm Bureau Federation Principles for Farm Data, and 2015 New-Zealand Farm Data Code of Practice), "although co-written by farmers' associations, have the declared objective of gaining producers' trust for agribusinesses, so they seem to reflect the perspective of agribusinesses and the impression is that codes include what agribusinesses are ready to accept".
- Robust and precise **data governance policies** at the organizational level are key. System owners and companies managing farm data could increasingly endeavour to develop specific policies detailing their commitment regarding their collection, use, and sharing of smallholders' farm data. Such policies should take into account the risks highlighted in Section 2, as well as smallholders' interest at each stage of the data life cycle (Section 3). They could be made freely available in a more systematic way (for instance, through those actors' websites).
- When sharing data, particularly production plot data for due diligence compliance, organizations should more systematically conclude appropriate **data sharing agreements**, ensuring that their own commitments to data governance are further passed on to entities that the data is shared with.
- Some useful **templates, guidance, and other support resources** already exist: for instance, ISEAL's template data sharing agreement (ISEAL, 2020b).[13] Additionally, open resources could be developed, and existing ones could be shared more widely.

In addition, there is also a need to collectively set-up grievance and redress mechanisms going beyond single organizations. Grievance and redress mechanisms refer to the processes through which farmers can contest harmful outcomes, seek correction, or demand accountability when their data is misused or when decisions based on data exclude them from markets or certification schemes. In agricultural supply chains, such mechanisms are rarely available, particularly when data is shared with multiple actors, leaving smallholders with limited options to contest inaccuracies or inappropriate data sharing. Digital public infrastructure could potentially facilitate the set-up of appropriate grievance and redress mechanisms for smallholders in a complex data environment (see Section 4.3).

Whether for setting up collective governance frameworks, codes of conduct, data sharing agreements, or collective grievance and redress mechanisms, voluntary commitments and collaboration between relevant supply chain actors is crucial. Organizations that request data from suppliers have a responsibility to encourage good data governance practices. For instance, they could request from their direct and indirect suppliers the implementation of basic principles and commitments to abide by relevant codes of conduct. In this process, they should be wary about resource and financial constraints induced by the data collection and the implementation of fair data practices and passed to upstream actors.

Several approaches have been highlighted in recent studies: USAID (2023) points to the importance of including contractual provisions for redress and establishing grievance forums within stewardship arrangements; the German Agency for International Co-operation (GIZ, 2022) shows how farmer-centric platforms, such as cooperatives or personal data stores, allow farmers to revoke consent or monitor data use, enabling practical forms of redress; and Fripp *et al.*, (2023) stresses that credible traceability systems must also provide processes to register and address grievances.

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[12] See Section 7.9 of the publication.

[13] See Annex of the publication.

The Findable, Accessible, Interoperable and Reusable (FAIR) Principles can provide some foundation for ethical and effective data governance. Originally developed by the research community,[14] these principles are relevant for ensuring equitable access and responsible data sharing in supply chains involving smallholders. The principles include:

- **Findable**: Data should be easily discoverable by both humans and machines. This requires rich metadata and persistent identifiers, ideally through recognized repositories or portals. Smallholder data – such as production volumes, farming practices, or land use – often remains poorly visible in global systems, particularly to farmers themselves. Making this data findable ensures smallholders are recognized and better informed.
- **Accessible**: Data must be retrievable via standardized protocols, with clear conditions for access and reuse. Sensitive data (such as personal or proprietary information) should have transparent governance around restrictions. Equitable access could mean that smallholders can benefit from insights (such as market trends, compliance with due diligence legislation within supply chains, and climate data) while also having control over who accesses their own data, as well as protecting their rights and privacy.
- **Interoperable**: Data should be compatible with other datasets and systems. This involves using shared vocabularies, standards, and formats that enable integration and analysis across platforms. Where smallholder data is interoperable, it can be combined with other datasets (such as satellite imagery and supply chain data flowing between different IT platforms or tools) to improve traceability, optimize resource use, and lower access barriers.
- **Reusable**: Data should be well-described and licensed to support replication and adaptation. Metadata must include provenance and contextual information to ensure meaningful reuse across different settings. FAIR encourages reuse with proper attribution and context. This protects smallholders from exploitation and ensures their data contributes to research, policy, and commercial applications in ways that respect their contributions and rights.

Centre for Agriculture and Bioscience International (CABI), Fairfood, and Ag Data Transparent (ADT) are examples of organizations putting FAIR Principles into practice.

4.2. FIT-FOR-PURPOSE LEGAL FRAMEWORKS

There is a notable lack of comprehensive legislation that specifically governs the collection, dissemination, and utilization of agricultural data (Jouanjean, 2020). Setting up legal frameworks to strengthen data governance in supply chains cannot be achieved by national governments acting alone. Data governance in global supply chains is a cross-jurisdictional challenge, and effective regulatory approaches as an entry point to improvement require intergovernmental coordination.

The absence of explicit legal protections may leave farmers without control over their data and without effective avenues for recourse, as agribusinesses hold a significant influence within the agricultural data ecosystem, often shaping or capitalizing on the absence of comprehensive legal structures. Although the lack of comprehensive regulatory frameworks and standards may create uncertainty for agribusinesses (Jouanjean *et al.*, 2020), it also grants them flexibility to unilaterally define terms. Ongoing ambiguities regarding the classification of agricultural data across various jurisdictions leads to inconsistent and often insufficient protections for farmers.

Personal data protection (PDP) regulations are increasing globally; they can provide important safeguards. Those enshrine specific, precise rights for data subjects regarding their personal data. Data is considered personal if it can be linked to an identified or identifiable individual. Farmer identification data and farm data clearly link back to a specific smallholder, and can therefore qualify as personal data. However, some farm data may not qualify as personal data and would therefore fall outside the scope of existing PDP regulations.

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[14] FAIR Principles were formally introduced in March 2016 in a landmark paper, FAIR Guiding Principles for scientific data management and stewardship, published in the journal, *Scientific Data* (2016). They were developed by a consortium of scientists, including Mark D. Wilkinson and other experts from academia, industry, and publishing. The initiative emerged from growing concerns about the usability and accessibility of research data in an increasingly digital and data-intensive scientific landscape.

For instance, anonymized production plot boundaries without attributes may not directly be linked back to a specific individual – even more so if they are generated from publicly available Earth observation data (such as satellite imagery made available to the general public).

European Union GDPR and its core principles

The GDPR, adopted in 2018, aims to protect individuals' rights over their personal data, particularly in light of rapid digital technological developments. It has been a front-running legal framework, shaping the debate around data privacy. It has driven substantial changes in corporate practices, although enforcement and oversight remain challenging. It defines the concept of a "data subject" and establishes key principles, including rights to:

- transparent communication (art. 12–14);
- access to the information (art. 15);
- rectification (art. 16);
- erasure (art. 17);
- restriction of processing and automated decision-making (art. 18); and
- data portability (art. 20).

Additionally:

- Consent must be explicit, informed, and capable of being withdrawn.
- Data protection must be embedded in systems and processes.
- Organizations must demonstrate compliance through documentation and transparent communication.

Other relevant PDP regulations globally

Similar PDP regulations have been adopted globally, including:

- regional level in Africa: Economic Community of West African States (ECOWAS) Data Protection Act, African Union Convention on Cyber Security and Personal Data Protection;
- national level in Africa: Chichaibelu (2024) mentions that "as of May 2023, 34 out of 54 African countries had adopted data protection laws and several of the remaining countries were working on related legislation";
- Canada's Personal Information Protection and Electronic Documents Act;
- Brazil's Lei Geral de Proteção de Dados [General Personal Data Protection Act] (LGPD);
- Japan's Act on the Protection of Personal Information (APPI);
- India's Digital Personal Data Protection Act, passed in 2023;
- Singapore's Personal Data Protection Act (PDPA); and
- Thailand's Personal Data Protection Act (PDPA) (effective 2022).

It is estimated that more than 100 countries have personal data protection legislation in place.

Beyond the fact that not all production plot data constitute personal data, the effective use of PDP regulatory frameworks is challenged by:

- Their fragmented and uneven nature, particularly in environments involving multiple jurisdictions – where commodities are produced, traded, or processed; where organizations holding the data are registered; and where data is physically stored (such as cloud-based infrastructure data centres).
- Their effective enforcement level: The majority of the case studies presented in this report (see Section 6) show that despite legal frameworks being in place to protect personal data, there is evidence of insufficient enforcement, ambiguities, difficulties to obtain registries, reluctance of smallholders, and lack of resources by authorities, resulting in some serious inconsistencies. Because PDP regulations are not sector-specific, enforcement in the agricultural sector is often deprioritized, particularly in countries where the sector remains largely informal.

In fewer cases, certain regulations extend these principles beyond personal data. The European Union Data Act (Regulation [EU] 2023/2854) extends the access principle to data generated by connected products and related services, granting users (including farmers) rights to access and reuse non-personal data from machinery, sensors, and devices. Together with the European Union Data Governance Act (2022), these regulations underscore user control and data portability. For smallholders, this may entail the ability to access their own yield or geolocation data from a cooperative or agritech platform and utilize it with alternate buyers or service providers. However, effective enforcement remains challenging, and the rights of access and portability may be ineffective in practice if data subjects lack digital literacy, bargaining power, or the technical infrastructure required to exercise them (Jouanjean, 2020).

To compensate absent, scattered, or incomplete legal frameworks, voluntary codes can be established and functional – for instance, PDP regulations are sometimes voluntarily implemented even in jurisdictions lacking similar rules and/or are voluntarily extended to smallholder farm data, beyond farmer personal data. To date, these initiatives are predominantly industry-driven. Their self-regulatory nature and lack of legal enforceability (European Union Code of Conduct, 2018) have resulted in weak accountability mechanisms that tend to favour more influential stakeholders.

Stronger and more fit-for-purpose regulations are therefore still needed. To ensure better smallholder data governance:

- data protection regulations could be better aligned across jurisdictions, both in terms of definitions and rights granted, in order to ease implementation in global supply chains;
- coverage should extend across relevant jurisdictions to avoid incentives to store data in countries with lower protection levels; and
- regulations should more specifically target the agricultural sector, particularly smallholder contexts, to improve suitability and implementation – relevant regulations could more strongly adopt a smallholder perspective when being drafted or revised (they could especially include participatory approaches to directly involve smallholders in their design).

4.3. DIGITAL PUBLIC INFRASTRUCTURE (DPI)

Several of the risks identified in Section 2 are related to or exacerbated by proprietary, fragmented systems that operate in isolation. To remedy those issues, a growing number of actors are supporting and developing DPI. While the target audiences for voluntary commitments and legal frameworks are clearly divided into non-governmental and governmental actors, the institutionalization of DPI can involve both actor types. It also necessarily involves technical digital skills, whether from actors within the usual stakeholders or specialized IT organizations (developers, solutions providers, etc.).

Digital public infrastructure refers to foundational digital systems and services that are publicly governed and accessible to all, analogous to physical infrastructure such as roads or electricity networks. A core objective is to move beyond fragmented, siloed systems to create a unified, trustworthy data ecosystem for all stakeholders (UNDP, 2025).

Systems that are enabled by DPI aim to address systemic challenges in agricultural data governance, including information asymmetry, high transaction costs, barriers to access, and lack of trust by (Vital Wave, 2024; Open Agri Net, 2024; GIZ, 2024):

- reducing duplication and fragmentation of data systems: DPI building blocks are by design modular, minimalist, interoperable and reusable;
- enhanced data interoperability and standardization: DPI builds on open standards and specifications, enabling different systems and applications (from farm sensors to retailer Enterprise Resource Planning [ERP]) to communicate seamlessly and reduce data silos;
- improved transparency and inclusivity: integrating DPI building blocks into systems increases the number of actors able to contribute to or access information directly, thereby strengthening trust in digital systems – the use of DPI encourages global knowledge exchange, including South–South exchange, and allows actors to efficiently learn from each other and adjust functional models or solutions to their own context more easily; and

- reduced transaction costs and increased efficiency: by unifying data exchange on shared platforms at scale, DPI aims to significantly reduce the costs and complexity of accessing and verifying information.

Digital public infrastructure may effectively enable more equitable and resilient forms of data governance in global agricultural supply chains, providing meaningful opportunities to improve smallholder data governance.

However, the use of DPI is not a silver bullet that will address all data governance challenges. To ensure that DPI building blocks and enabled systems meaningfully improve the governance of smallholder farm data and address the risks identified in Section 2, they will need to be: effectively accessible, practical and useful to smallholders; and adopted and trusted by the other actors using and interacting with the production plot data (government agencies, agribusinesses, etc.). To this end, the very design of systems using DPI needs to include the perspectives of smallholder farmers.

As with any type of digital system, the effective inclusion of actors that have a lower level of digital literacy also depends on the visibility and knowledge of a solution (knowing that it exists, where to access it, and how to use it), as well as the design of the user interface and user experience. Smallholder farmers can still be excluded from digital systems, even with the use of DPI. Furthermore, DPI systems may also replicate technology bias that marginalizes smallholders and Indigenous Peoples (as highlighted in Section 2.1.5). Digital data exchanges over public channels may also be more vulnerable to cyberattacks, and the use of DPI requires robust policy setting and regulatory oversight to protect users, particularly smallholders, from exclusionary policies and surveillance practices. Additionally, further development and uptake of DPI systems and services may be hampered by a lack of coordination (Proforest, 2025; OECD, 2020; Sestak *et al.*, 2023; Prism, 2025).

Examples of promising and high-impact DPI building blocks in the agricultural sector include (Vital Wave, 2024; Proforest, 2025):

- registries, including farmer registries, plot and crop boundaries, etc.;
- digital identification and verification systems, facilitating traceability and data sharing, including tools enabling producers to generate their own data;
- data standards and exchange protocols, including dedicated data vocabularies and ontologies, as well as traceability standards; and
- standardized public datasets that are easily accessible – for example, via application programming interfaces (APIs), such as crop maps, soil maps, market data, and pest surveillance data.

Initiative for Sustainable Agricultural Supply Chains Traceability (INATrace) is an open-source digital traceability system initiated by GIZ designed to make agricultural supply chains more transparent and inclusive. It is especially tailored to meet smallholder farmers' needs. It enables end-to-end traceability of agricultural products – from farm to final buyer – by digitally recording key supply chain data such as geolocation, harvest dates, processing steps, and prices paid. It provides transparency in pricing, product origin, and sustainability attributes, as well as enables digital transformation. It also includes both desktop and mobile apps accessible on GitHub (INATrace) for data entry (polygon mapping), visualization, and supply chain management. It is fully open-source, allowing customization and scalability. For geospatial data management, it uses GeoIDs and integrates with FAO's Whisp tool[15] for deforestation risk assessments based on mapped farm plots.

The Digital Integration of Agricultural Supply Chains Alliance (DIASCA) is a global, multistakeholder initiative that brings together more than 600 actors across governments, industry, civil society, research institutions, and development organizations to co-create DPI for agriculture. Its activities engage governments, producer organizations, exporters, technical partners, and open-source communities to work on a global and national level. Through dedicated working groups on traceability, living income, and forest monitoring, DIASCA supports the development of open-source tools, governance frameworks, and technical protocols that strengthen trust, interoperability, and scalability across agricultural supply chains; DIASCA promotes more inclusive, transparent, and sustainable agricultural supply chains with a focus on smallholder farmers.

The AgStack initiative is an example of an agriculture-specific DPI programme. It is envisioned as an open-source, open-standard, and interoperable public good. Its foundational components, such as Farmer Registries,

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[15] Whisp refers to the full name of the tool: What is in that plot?

Farmland Registries, and Crop Registries (all designed as verifiable digital credentials), aim to connect producers, government agencies, private enterprises, and non-profits to deliver services at scale. AgStack is funded by the Linux Foundation, which emphasizes that “public” infrastructure does not necessarily mean government-owned or government-funded.

Other examples include the FAO Open Foris suite of tools, including Whisp, or ICT Deforestation-Free Trade Gateway. Publicly available datasets, such as the Universal Mill List, the West Africa Cocoa Dataset, and national land cover maps, also form part of these public digital tools, although they are technically more digital public goods than infrastructure.

One application of DPI is to enable farmers to collect and share their own data through accessible DPI systems, thereby effectively retaining ownership and control over that data. This connects to the concept of data sovereignty (GIZ, 2022), defined as the right of an individual or farmer to exercise control over their own data: determining who has access to it, under what conditions, and with what capabilities to access, amend, or reutilize it. The concept of self-sovereign identity (SSI) is a model giving individuals full control over their personal data, without relying on centralized authorities such as governments or corporations.

This concept materializes through the use of digital wallets that store identity credentials, which can be presented to third parties for verification and use. Challenges to scaling up and implementing such farmer-centric data wallets include limited digital literacy and the absence of public infrastructure needed to avoid continued reliance on siloed proprietary systems.

Initiatives such as FarmStack in India establish digital infrastructure that enables farmers to determine what data to share, with whom, and under what conditions. Digital Green characterizes FarmStack as a “farmer-centric data sharing infrastructure” that positions farmers at the core of the decision-making process regarding their own data.

Innovations around blockchain-enabled digital identities, such as data wallets from Centro Internacional de Mejoramiento de Maíz y Trigo [International Maize and Wheat Improvement Center] (CIMMYT) for smallholders, offer real-world models in which farmers can own, control, and decide how their data is used, thereby enhancing trust, traceability, and privacy within the system (CGIAR, 2024).

Other potential DPI use cases include the management of farm information beyond geospatial data, as well as enhanced grievance mechanisms.

It is indeed noteworthy that a lot of considerations are currently given to the collection and sharing of geospatial data and associated attributes, in particular for EUDR compliance, while the collection and sharing of other farm data through supply chains (transaction data, land use data, data on the use of labour and the use of pesticides, etc.) remains relatively unaddressed (Proforest, 2025). Digital public infrastructure could also hold a greater role in this area, which can cover even more disparate and uncontrolled practices, in addition to the fact that they cannot always be anonymized; DPI could seek to minimize the amount of data collected through building a collective understanding of the application of legality requirements in a given context and through other innovative mechanisms.

It may also be valuable to examine how DPI could potentially support the development of cross-system grievance and redress mechanisms for farmers, especially when data is extensively shared across multiple supply chain actors and can lead to market exclusion (Section 2.1 and Section 3.3).

Finally, appropriate and sustainable financial models are yet to be explored and established to absorb the cost of funding and maintenance of DPI products: Proforest (2025) highlights that while public, the future maintenance of these tools depends on exploring different business cases, including through public funding and company funding.

5. Conclusions

Sustainability and associated due diligence objectives are important drivers of the collection and extensive sharing of farm data, in particular plot boundaries data and associated attributes, as well as other data used to evidence the legality of production or to ensure the traceability of production. Current practices are insufficiently addressing smallholder farmers' interests and agency in these data collection, use and sharing exercises, with associated risks ranging from market exclusion to technology bias, diminishing farmer autonomy or data misuse.

Across contexts, current practices on securing consent often fall short, with poorly understood or pressured consent when tied to access to inputs, certification, or markets. While recognizing broader power imbalance of global agribusiness supply chains and practicalities, such as technical or resource constraints, there are clear improvements to encourage in securing and maintaining consent to data use and sharing from data subjects.

Once data is collected with adequate consent, governance depends on clear, enforceable permissions for access, modification, deletion, and use – covering both internal roles and external partners. Too often, farmers cannot view, correct, or retrieve their own data, and responsibilities for protection (security, retention, breach notification) are unclear or inaccessible in practice.

Furthermore, data sharing is both unavoidable – such as for end-to-end traceability and compliance with due diligence regulations – and risky when unmanaged. Good practice centres on consented, purpose-bound sharing under formal agreements that restrict access, use, further sharing, and security. Minimization and deidentification can act as safeguards, with auditable tracking of who received what, enabling revocation and grievance handling. Portability and interoperability are key to prevent vendor lock-in and strengthen farmers' agency (their ability to act independently, make informed decisions, and retain control over their data and choices), as well as their bargaining power. They also enable reliable end-to-end traceability and compliance with due diligence regulations, areas that carry significant risk when unmanaged. Good practice centres on consented, purpose-bound sharing under formal agreements that restrict access, use, further sharing, and security.

Three levers can accelerate systemic improvement on practices at these different stages of the data journey: voluntary commitments and efforts; stronger regulatory framework; and technical solutions through developing a DPI. A unifying requirement across those levers is to adopt an inclusive, farmer-centric design that recognizes both individual and collective dimensions of agricultural data. Meaningful participation of farmers and their organizations in system design and rule setting – not just consultation – builds legitimacy, improves practicality, and ensures effective protection of farmers' interests. First, voluntary commitments and efforts are key to strengthen farm data governance. Some of it can happen at the organizational level – by setting up organizational data policies clearly defining how farm data is to be collected, managed and used, by ensuring access or portability of data back to farmers, or by streamlining the use of data sharing agreements. It is however important that things do not stop at the intra-organizational level. Indeed, we fall short of protecting smallholders' interests precisely because their farm data lives in a complex environment where roles and responsibilities are not clearly defined. This calls for collective multistakeholder action to define better practices at data governance. Governance frameworks and codes of conduct are examples of collective tools improving existing practices, provided they are genuinely farmer-centric and resourced for uptake. Maintaining collective spaces for discussion to exchange on resources, examples, and successes is also an important element:

- **increase the visibility and circulation of existing support resources**: a wealth of available content is already actionable, whether specific to agricultural due diligence or applicable to broader data governance contexts (Annex 1 of this report offers a small recension and typology of existing resources; it is suggested to develop a more accessible and interactive repository of agricultural data governance resources);
- **develop a cross-country, cross-sector** code of conduct for collecting smallholder production plot data for sustainability and due diligence purposes, building on existing principles and ensuring participatory design (such a code of conduct could build on existing national versions and already-established principles, such as Fair & Smart Data Governance Principles; mechanisms to track commitment and implementation could also be explored);
- **create actionable guidance on robust consent** tailored to geospatial and legality data collection, aggregating good practices, and existing resources into practical formats; and

- **provide clear guidance on organizational data policies and sharing agreements**, referencing existing templates (**Global Open Data for Agriculture and Nutrition** [GODAN], ISEAL, Kenya Ministry of Agriculture) and bridging gaps on implementation.

Fit-for-purpose regulatory frameworks remain key to change practices on a large scale. Personal data protection laws are a start, although they only partly cover farm and geospatial data and are unevenly enforced across jurisdictions. Aligning definitions and rights, extending coverage to non-personal farm data where appropriate, and embedding participatory drafting processes would make protections more effective:

- **further explore how existing PDP regulations could be adjusted or extended** to farm data managed and shared in a multijurisdictional environment; and
- **strengthen monitoring and enforcement mechanisms** where existing PDP regulations are not implemented in the context of using and sharing farm data in global agribusiness supply chains.

Digital public infrastructure – farmer/plot registries, open standards, secure exchange protocols, and public datasets – also bear the potential to reduce data fragmentation, improve interoperability, and lower transaction costs, while enabling models where farmers collect, control, and share their own data. Digital public infrastructure is not a panacea; inclusion, security, and governance safeguards are prerequisites to avoid reproducing biases or creating new vulnerabilities:

- **build knowledge on farmer data wallets and self-managed systems**, exploring scalability, financial models, and interoperability conditions;
- **strengthen understanding of farm data for legality evidence** and how DPI can support secure, privacy-conscious sharing for compliance (such as EUDR); and
- **explore DPI-enabled grievance and redress mechanisms** to allow farmers to correct inaccurate plot boundaries, flag exclusion, and seek remedies when data misuse leads to market exclusion.

Aligning voluntary, regulatory and technical action for systemic transformation

Looking ahead, it seems important that all three overarching approaches are mobilized simultaneously with the shared objective of better safeguarding smallholders' interests in participating in global agribusiness supply chains and associated data systems. A combination, or a smart mix of combined actions, is necessary. Different groups of stakeholders may work in parallel to develop different elements: some may be more interested in developing a shared code of conduct, others can participate and pilot the development of farmer-centric data wallets. Provided that those are going in the same direction, and ideally, that there are dedicated spaces of interaction and alignment, they should progressively achieve better data governance objectives.

Whether designing governance principles or developing concrete technical solutions, the sector must embrace inclusive design, interoperability, and farmer-centric approaches as principles. Coupled with investments in digital literacy and DPI, these innovations can transform agricultural data systems from being fragmented and opaque into transparent, equitable, and resilient networks – where smallholders not only comply with global standards but also derive tangible benefits from their data.

6. Case studies

6.1. Cocoa: Colombia

The cocoa sector in Colombia and the role of smallholder farmers

Colombia is the tenth largest global cacao producer. To date, most cacao produced in Colombia is consumed domestically. The top five export destinations in 2023 were the United States of America, Ecuador, Mexico, the Bolivarian Republic of Venezuela, and Chile. Colombian cacao exports to the European Union have grown to annual sales totalling about 15.5 million USD in 2023 (USDA, 2024).

The National Federation of Cocoa Growers (Fedecacao) is a key provider of technical assistance to farmers, research, and market support. There are two multinational companies that purchase and process about 80 percent of cocoa produced in Colombia: Grupo Nutresa with Compañía Nacional de Chocolates and Casa Luker. Smallholder farmers manage most cocoa production, with average farm sizes of around 3 hectares (USDA, 2024).

In 2020, the Colombian government formalized its commitment to zero deforestation through the National Policy for Deforestation Control and Sustainable Forest Management (also known as CONPES 4021). The policy aims to achieve net zero deforestation and strengthen governance of ethnic groups and farm communities dependent on forests (European Union REDD Facility, 2021).[16]

6.1.1. Existing approaches to data collection and management

Despite strong national deforestation policies and European Union market demand highlighting the need for unified information-sharing systems, Colombia does not have a government-led platform to collect data for deforestation-free commodities (European Union REDD Facility, 2021). As reported by UNDP, coordination challenges among Colombian ministries in managing deforestation-free compliance does not facilitate data management at the national level (UNDP, 2020).

Efforts to collect and manage relevant production plot data has therefore been led by the private sector, federations and other entities in Colombia, which results in uneven situations. While large exporters have managed to develop rather robust systems, small and medium actors face significant limitations in managing the required data. Cocoa exporters and cooperatives highlight several bottlenecks in the development of traceability efforts, which include the lack of standardization in formats demanded by international clients, hampering data consolidation, and the cost and burden of additional compliance requirements (such as requirements for external audits). In addition, stakeholders also highlight that limited access to technology, weak internet connectivity, and insufficient technical staff prevent the adoption of traceability systems at the local level. Cocoa exporters and cooperatives have emphasized the importance of prioritizing smallholder and traditional producers in project efforts and voiced concerns about the protection and privacy of sensitive farm data.[17]

The AIM4Commodities initiative is supporting cooperatives in Colombia by deploying digital solutions such as Open Foris Ground (for collecting farm geometries) and Whisp (deforestation-risk analysis), as well as facilitating the integration of national forest cover layer of Instituto de Hidrología, Meteorología y Estudios Ambientales [Institute of Hydrology, Meteorology and Environmental Studies] (IDEAM) into Open Foris Whisp (to help reduce false positives on high deforestation risk). As of November 2025, AIM4Commodities has engaged with six cooperatives and producer groups in Colombia (Corpoteva, Workakao, Cortepaz, Chocolate Tumaco, EcoInsitu, Oruakos (Indigenous Peoples), and the Asociación de Mujeres Productoras Agropecuarias de El Carmen de Sotará (AMPACS) rural women's group, supporting them in adopting Open Foris Ground and Whisp solutions for traceability. Over 1 100 cocoa plots have already been mapped with Ground across multiple regions, and Whisp is being used to conduct deforestation risk analysis, including by Fedecacao, ColCocoa, and Red Cacaotera.

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[16] REDD refers to the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries.

[17] In April 2025, the FAO-led AIM4Commodities initiative organized a workshop, bringing together cocoa exporters and cooperatives in Colombia. A first panel highlighted bottlenecks in deploying traceability efforts and a second panel explored local-level challenges.

Fedecacao has applied Whisp to analyse 83 000 plots, with very low false positives due to the integration of IDEAM's national forest cover layer, and is now planning to use Ground to further improve data quality.

To complement private sector deforestation-free data collection efforts, Fedecacao identified the need for a centralized dataset including geolocation data for EUDR compliance, with the goal of facilitating the access of Colombian farmers to markets requiring deforestation-free data (Fedecacao, personal communication, 2025). To this end, Fedecacao conducted a farmer census, for which outcomes have been made available by the end of 2025. The census was conducted based on a survey including 290 questions on social, environmental, and deforestation data from farmers. The survey was sent directly to farmers to complete, allowing them to control the data they provide. The team of Fedecacao agronomists across Colombia supported farmers to conduct field observations and collect georeferenced data for the census (Fedecacao, personal communication, 2025). As of October 2025, 92 percent of registered Fedecacao farms had participated in the census and were georeferenced. Fedecacao representatives stated their goal of having 100 percent of farms associated with Fedecacao georeferenced and prepared for compliance with the EUDR by the end of 2025. They have also planned to collaborate with corporations and government agencies to support EUDR preparedness and to incentivize government investments in regions requiring support to improve the livelihoods of farmers. As it is a recent development and remains a work in progress, limited information has been shared with stakeholders about the Fedecacao dataset, and it is not yet entirely clear who will have access to it or under what conditions.

Nutresa's smallholder programme – implemented since 2024 to face market demand from the European Union for Colombian cocoa – is a good example of multinational organizations' efforts to formalize the collection of deforestation-free data (Nutresa, personal communication, 2025). The smallholder programme aims at collecting deforestation-free data through its company, Compañia Nacional de Chocolates, in partnership with Farmforce, a Norwegian traceability technology platform (EIN Presswire, 2024). The programme works directly with smallholder farmers and offers premium prices to those who agree to take part in the collection of deforestation-free data. Once smallholder farmers agree to participate in deforestation-free markets under the programme, local agronomists conduct on-farm visits to collect data (Nutresa, personal communication, 2025).

6.1.2. The status quo of data governance

As per the Colombian national data privacy laws (Law 1581 and Law 1251), smallholder farmers must consent to data collection. The data privacy laws define personal data and entitle farmers to receive a written policy from the data collector, outlining their data privacy and protection rights. Personal data can only be used with the "informed consent" of farmers, as stated in Law 1581.[18] This implicitly requires that consent be communicated clearly to farmers – for example, in their native language – but the law does not explicitly address language as a potential barrier. Additionally, it does not explicitly require consent to be provided in writing, which may create challenges for smallholder farmers.

The legal framework in place also mandates that data collectors ask for further permission from smallholders in order to use their data for any reason other than those stated in the initial data sharing agreement or in order to share data with any external parties (DLA Piper, 2025).

Under Law 1581, data collectors are responsible for protecting data from damage, making it accessible to data subjects, and correcting data if farmers identify inaccuracies. For cross-border transfers, the law permits personal data to be transferred only to countries with data protection laws considered equivalent to those set in Colombia (the law contains a list that includes the European Union).[19]

Lastly, under the right to privacy and the right to data rectification pursuant to the authority of the Colombian Constitution, farmers have the right to bring a court case to require data collectors to modify, secure, or delete personal data if it violates their constitutional rights (DLA Piper, 2025). However, it can be challenging for farmers to bring such cases to court, based on limited disposable income and time to challenge larger organizations.

Regarding implementation of the legal framework in the cocoa sector, multinational companies state that they have procedures in place to protect smallholder data in compliance with national data privacy laws. Representatives from the Nutresa group highlight their commitment to enforce data privacy and support smallholder farmer's interests with their dedicated programme implemented by the group's company,

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[18] https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=49981

[19] https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=49981

Compañia Nacional de Chocolates. Smallholder farmers' consent is obtained before collecting and sharing their data. Data is collected by local agronomists only after smallholder farmers agree to participate (Nutresa, personal communication, 2025).

On the side of Fedecacao, representatives expressed their efforts to protect the data of smallholder farmers by following the requirements of the Colombian data protection laws. For each farmer that participates in the census, the Fedecacao team shares a document outlining their data privacy rights and requires farmers to sign a consent form. Fedecacao also states that when farmer data is transferred from the census to companies interested in the data to export their product to the European Union market, this data is anonymized. Some of the data included within the census include personal data such as financial information, gender, and ethnicity, underscoring the importance of compliance to Colombia's data privacy laws to protect smallholder farmers. Some farm data is already aggregated and shared publicly by Fedecacao (Fedecacao Census Draft, 2025).[20]

Interestingly, Fedecacao also explains that when initiating the program, building sufficient trust with farmers for them to participate was a challenge. Some farmers expressed concern that participation could result in higher taxes to the government. Ultimately, with Fedecacao's successful implementation of projects to improve farmer livelihoods, they have been able to overcome resistance and earn the trust of farmers to get significant participation in the census. It is noteworthy that farmers' willingness to share farm data appears to be influenced less by formal precautions taken during the collection (explanation, data privacy rights notice, consent form) and more by tangible improvements to livelihoods.

6.2. Coffee: Kenya

The coffee sector in Kenya and the role of smallholders

- According to FAO, in 2023, Kenya ranked nineteenth in the world in terms of coffee production by volume.
- Export to the European Union represents more than 50 percent of Kenya's coffee market (USDA, 2025a).
- Smallholder farmers account for 70 percent of coffee production in Kenya. Kenya's Coffee Directorate of the Agriculture and Food Authority (AFA) estimates that there are 1.2 million coffee farmers in Kenya, but no national data exists on how many are active. Coffee smallholders are grouped into cooperatives. In 2022/23, 605 active cooperatives operated 1 122 primary wet mills (EFI, 2025).
- Around 3 000 estate owners of larger farms (FAO, 2025) also coexist with smallholder farmers.

In the coffee supply chain, brokers (licensed intermediaries) facilitate the sale of coffee at the Nairobi Coffee Exchange (NCE). The NCE operates under the oversight of the Capital Markets Authority and the Kenyan AFA.

6.2.1. Existing approaches to data collection and management

Currently, there is no nationwide registry of growers (cooperatives or estates) and farmers in Kenya (Ministry of Agriculture Data Governance Framework, 2022), despite coffee farmers' profile data becoming increasingly available through various systems, including government-led initiatives and registration efforts.

The Kenya Integrated Agriculture Management Information System (KIAMIS) is the centralized digital platform for cross-commodity agricultural data in the country, which focuses on farmer registration to improve agricultural management. It includes farm details (name, contact, farm size, crops grown) and geolocations (GPS coordinates). Compliance with the EUDR has been a primary driver to adjust systems and collect data. To this end, the AFA – together with the Directorate of Resource Surveys and Remote Sensing (DRSRS), the Kenya Forest Service (KFS) and the Kenya Space Agency (KSA) – are leading a nationwide geo-mapping initiative. This includes mapping coffee plots using satellite and field data, training enumerators across 33 subnational counties, aligning with Kenya's Data Protection Act and building a national information system which maps farmer's details and captures famers details. This includes farmer details to validate the origin and legality of coffee production. This coffee-specific system will integrate with KIAMIS to ensure coffee data is part of the national agricultural database. Kenya highlights that the KIAMIS system has already registered 6.6 million farmers and another 500 000 added during a campaign launched in August 2025 (Kenya News, 2025).

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[20] https://www.fedecacao.com.co

In parallel, FAO's AIM4Commodities initiative has been piloting the tools, Open Foris Ground and Whisp, with cooperatives from multiple coffee-producing counties. These tools aim to enable farmers to map plots, collect sustainability data and conduct deforestation risk assessments to produce evidence for compliance with market regulations like the EUDR.

Cooperatives can also use a dedicated KoboCollect survey that had been set up by the Kenya Space Agency (KSA) for the purpose of collecting farm-specific data in Kenya. Cooperatives play a central role in Kenya's coffee supply chain and are increasingly viewed as key channels for data collection. However, many lack the capacity, reliable IT systems, and transparency needed for effective mapping and certification. Cooperative-led data initiatives are rare, and data ownership frequently remains a competitive issue. In some cases, private companies – mainly traders – hold data on behalf of cooperatives but restrict access (Kenyan Coffee Platform, personal communication, 2025).

On the side of voluntary certifications and schemes, Rainforest Alliance and Fairtrade are widely used in the coffee sector. Certification is often facilitated by Coffee Marketing Services (CMS), a leading agribusiness service provider in the country, as well as non-governmental organizations (NGOs) such as Solidaridad, which train cooperatives and farmers for compliance and collection of geo-data (COSA, 2019). Rainforest Alliance also launched the Deforestation Risk Assessment Tool to help uncertified farmers meet EUDR requirements by uploading farm geolocation data and generating compliance reports.

In addition, the private sector – mainly exporters with a presence in Kenya – has also been collecting data, particularly for EUDR compliance. Some have even provided smallholders with smartphones and tablets to help them collect data.

Also relevant, the Global Coffee Data Standard – developed by the Global Coffee Platform (a multistakeholder association) – is a collaborative framework that defines 15 key indicators that span across economic, social, and environmental dimensions for assessing farm-level sustainability in coffee production. These indicators, such as farm ID, location, average price, and fertilizer use, were agreed through a multistakeholder process involving experts and practitioners. While the standard supports potential data exchange between business partners or sustainability schemes, it emphasizes data sovereignty, where each party retains control over its own data and is not obligated to share it. Although the Coffee Data Standard is not yet widely adopted in Kenya, efforts are underway to align national systems with its principles.

While coffee farmers' profile data is increasingly available, it remains fragmented across systems, with limited functional data reconciliation and integration. Achieving full coverage requires database consolidation, as well as additional farmer registration. There however is a growing connection and coordination between state-led mapping and other data collection efforts such as private certification systems, especially in response to the EUDR. A study led by the European Forest Institute (EFI, 2025) advises that the data should be consolidated and harmonized to build a national database of coffee farmers that includes geolocation data of coffee plots and connects to the traceability system. Kenya's existing KIAMIS system is well-established, but it primarily functions up to the first point of processing (wet mills) and does not yet integrate farm-level geolocation data.

6.2.2. The status quo of data governance

Data collection and management is also protected in Kenya through relevant regulations and governance frameworks.

As per the national legal framework, the Coffee (General) Regulations (Legal Notice No. 120 of 2016) in Kenya (enforced by the Coffee Directorate of the AFA) mandate registration of all coffee growers with both county governments and the authority to facilitate centralized data collection. Coffee-related businesses must be licensed and comply with traceability and reporting standards, while growers are required to update authorities on any changes in farm operations. Quality assurance must be established through appointed inspectors who monitor compliance and traceability.

Farmers are considered data subjects under Kenya's Data Protection Act (2019). They have the right to informed consent, data access, and data correction. The Office of the Data Protection Commissioner (ODPC) is involved to ensure that the national geolocation campaign of coffee plots adheres to Kenya's Data Protection Act, safeguarding farmer privacy and data rights. Between 2022 and 2025, over 26 million KES in fines were issued across multiple sectors under the Data Protection Act. However, sector-specific compliance data for agriculture or coffee cooperatives is not explicitly broken out on the ODPC website.

Complementing these regulations, the Ministry of Agriculture's Data Governance Framework (2022) and the associated KIAMIS Data Governance Framework establish robust data protection standards aligned with Kenya's Data Protection Act (2019) and GDPR principles. It empowers farmers as data subjects with:

- the right to be informed of the use to which their personal data is being put;
- the right to access their personal data held by a data controller or processor;
- the right to object to the processing of all or part of their personal data; and
- the right to correction of false or misleading data and deletion of false or misleading data.

The KIAMIS Data Governance Framework notably includes template forms, procedures, guidelines, and other practical tools in its appendices.

Aside from legal requirements and the national Data Governance Framework, the Kenyan Coffee Platform (KCP), as part of the Global Coffee platform, has been working with government, producers and civil society on geolocation data collection sensitization and training, in particular to enable them to provide informed consent. The depth of the information collected (including fingerprints in some cases) is often questioned by farmers and can lead to suspicion about how the data will be used, including fears of losing their lands (Kenyan Coffee Platform, personal communication, 2025).

6.3. Rubber: Viet Nam

The rubber sector in Viet Nam and the role of smallholders

Viet Nam is currently the third largest producer of natural rubber in the world (after Thailand and Indonesia). It covers around 930 000 hectares of rubber plantations. Domestic production amounts to 1.3 million tonnes (9.1 percent of global production), and roughly the same amount of natural rubber is being imported for processing operations (Forest Trends, 2025).

Smallholder rubber production constitutes a significant component of the national rubber industry, occupying an estimated 490 000 hectares, or 54 percent of the total cultivated area. This segment contributes approximately 819 000 tonnes of latex annually, representing 63 percent of the country's total raw rubber output (Forest Trends, 2025).

In terms of trade performance, smallholder production accounts for roughly 74 percent of Viet Nam's total rubber export volume, encompassing both natural rubber and processed rubber products.

Usually, each smallholder household manages less than two hectares of rubber, often divided into one to three plots, although a minority may oversee five to seven plots. Due to the limited latex yield per household, direct sales to processing factories are uncommon. Instead, approximately 95 percent of smallholder latex is marketed through intermediary purchasing agents, who aggregate and supply the raw material to processing facilities (Forest Trends, 2025).

Certification schemes are engaged in promoting sustainable rubber from Viet Nam, namely the FSC with currently six active forest management certificates (FSC, 2025) and the Program for Endorsement of Forest Certification (PEFC) (via the endorsed Vietnam Forest Certification Scheme [VFCS]) with approximately 118 337 hectares certified area at the end of 2023 (Viet Nam Ministry of Agriculture and Environment Press Agency, 2024).

6.3.1. Existing approaches to data collection and management

In recent years, the Vietnamese government has emphasized digital transformation in agriculture, including natural rubber, by encouraging the use of digital farmer registries, geospatial mapping, and sustainability certification systems (Viet Nam Ministry of Agriculture and Environment Press Agency, 2023). This aligns with the national strategy for smart agriculture and international compliance, especially in light of the EUDR, which affects rubber exports.

The rubber supply chain in Viet Nam is characterized by a hierarchical and multilayered structure, in which smallholder farmers, agents or traders, and enterprises or factories perform distinct yet interdependent roles. Agents act as intermediaries, purchasing latex from smallholders and supplying it to processing factories. They often operate under contracts or partnership agreements with manufacturers, forming a tripartite model that has demonstrated operational effectiveness.

There is neither a single centralized national register of all rubber producers and plots, nor a central system for tracking and tracing rubber throughout supply chains.

Data collection is mainly orchestrated by enterprises and done through field surveys, with companies relying on local agents and officials to facilitate access to smallholder farmers. Smallholders often have to provide the same data to multiple agents and systems. Data collection can also occur informally, as collectors or agents may lack the knowledge or motivation to secure appropriate consent from data owners. This method can also present challenges in terms of data accuracy, duplication, and consent. Companies with strong local ties – particularly domestic companies – are often more successful in collecting data, as smallholder farmers are often reluctant to share information with unknown parties, especially foreign-invested companies. During the data collection process, farmers often question the purpose of data collection and express concerns about scams or abuse. However, once data has been provided, farmers tend to stop questioning how it is used.

The data types collected by these various actors usually include:

- **farmer identity information** (linked to household registries);
- **farm size and land use certificates** (Red Books or land titles);
- **geospatial data** (plot boundaries and GPS points);
- **production data** (year of plantation, latex yields, tapping records, sales transactions); and
- **sustainability indicators**, such as land use history and absence of deforestation, increasingly required by export markets.

Companies use a combination of internal platforms and third-party solutions to manage data. Some companies build their own systems (such as Dong Nai Rubber Corporation) to suit their needs, while others (commonly foreign direct investment [FDI] corporations) adopt platforms suggested and built by customers.

In organizing data collection and management, organizations often focus on technical factors and overlook social dimensions. Psychological barriers also arise in areas where there is a lack of well-informed support from local authorities. The cost and effort required to collect data directly from plantations are high, and only large companies or those with sufficient resources can build and maintain data systems.

6.3.2. The status quo of data governance

In Viet Nam, data governance practices are gradually aligning with international standards, particularly the GDPR. Businesses collecting data from smallholder farmers often act as data controllers, determining the purposes and means of processing. Data processors, such as agents or third-party platforms, operate under contractual obligations to process data on behalf of controllers. According to Viet Nam's Decree on Personal Data Protection (2023), data sharing must be transparent, with explicit consent and notification provided to data owners (smallholders).

However, according to a report (Dat Le and An, 2024) on the regulation of data transmission, Viet Nam's legal framework still lacks detailed definitions of non-personal data, anonymous data, and pseudonymous data, which can lead to ambiguity in enforcement. Unlike the GDPR, Vietnamese law does not recognize the concept of a joint controller, potentially creating accountability gaps when multiple entities are involved in data processing. Remedies for data governance violations include civil, administrative, and criminal sanctions, but enforcement remains limited. Strengthening these mechanisms, including the appointment of data protection officers and clearer definition of roles, is essential to improving data governance in the rubber supply chain and beyond.

In practice, businesses are generally aware of Viet Nam's Personal Data Protection Law (2023) and take the minimum steps necessary to ensure operational compliance. Practices of holding workshops to inform farmers about data collection for EUDR, setting up signed consent forms, and only sharing data which is encrypted and with selected third parties are indeed quite common. Despite these efforts and the adequate legal framework, challenges persist, and implementation and enforcement on the ground may be insufficient to ensure the rights of data subjects. Smallholders contribute an important part to the national production but are lacking representation and voice in the development of data collection and management systems. Data collection processes so far have been demand-driven, and the actual procurement of data may have been prioritized over securing the rights of data subjects.

However, there are a few examples highlighting good practices:

- Dong Nai Rubber Corporation (DONARUCO), a state-owned enterprise that owns its own rubber plantations, has implemented a robust data management approach that integrates both technical systems and internal compliance mechanisms. The company uses DNRC-GIS to manage geospatial data and DNRC-Traceability to track rubber transactions.[21] These systems are governed by role-based access control mechanisms, ensuring that only authorized personnel can access sensitive data. Internal compliance is maintained through a dedicated department that oversees the collection, processing, and protection of data. While DONARUCO is currently focusing on data from its own plantations, the company plans to expand its traceability system to include data from smallholder farmers in the future.
- Some companies have successfully developed smallholder rubber supply chains that align with EUDR requirements, although this is not at scale in the country. Forest Trends (2025) highlights that a few businesses have already begun to successfully sell traceable and EUDR-ready products to international markets, receiving better prices and recognition for their efforts. These models highlight the importance of building trust with smallholder farmers, engaging local governments, and investing in digital infrastructure.

6.4. PALM OIL: INDONESIA

The palm oil sector in Indonesia and the role of smallholders

Indonesia is the world's largest palm oil producer, supplying more than half of the world's palm oil. The total planted area is estimated around 14 million hectares, producing close to 50 million metric tonnes of crude palm oil (Trase, 2024; USDA 2025c).

More than half of the production is exported (with India, China and the European Union among the largest export markets), but the share of domestic consumption has been increasing recently (Trase, 2024; USDA, 2025). The share of smallholder production area is estimated at 40 percent (FERN, 2025).

Smallholder producers are either independent or plasma smallholders, the latter having closer ties to larger companies, which are providing technical assistance and market to the plasma scheme participants (FERN, 2025). The oil palm farmers union (SPKS) represents about 76 000 smallholders; the total number of smallholders is estimated at 2.7 million (FERN, 2025).

Traders and intermediaries (sometimes tiered) play an important role in sourcing from independent smallholders. Smallholders rarely supply fresh fruit bunches (FFBs) directly to palm oil mills.

Fresh fruit bunches are processed into crude palm oil (CPO) in palm oil mills, often sourcing a mix of FFB from vertically integrated plantations and external suppliers, typically from a 50 km radius. The next step is refineries that are large-scale operations preparing the CPO for export. Most mills and refineries are owned by a relatively small number of large corporations who are very influential in the supply chain.

The sector is governed by the Ministry of Agriculture, which also oversees the national certification scheme (ISPO); it is planned to become mandatory for all actors in the sector. In 2024, 5.68 million hectares of palm plantation were certified (IPO, 2024).

The international RSPO certification scheme is also an important player, with a certified area of roughly 2.5 million hectares in late 2023 (ASIAN AGRI, 2025). Smallholder production areas under RSPO certification are at a rather low level as barriers to certification for smallholders persist (FERN, 2025).

6.4.1. EXISTING APPROACHES TO DATA COLLECTION AND MANAGEMENT

Indonesia's palm oil data collection ecosystem is characterized by considerable complexity and silos. Many information systems also focus primarily on larger palm oil actors such as plantation estates, mills, and refineries:

- The Sistem Informasi Perizinan Perkebunan [Plantation Licensing Information System] (Siperibun) is a government initiative and a self-reporting platform allowing palm oil companies to report key data about their operations (including plantation business licenses, land cultivation rights, maps, etc.) on a periodic (biannual) basis; Siperibun is not intended for smallholder use.

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[21] **DNRC-GIS refers to the Montana Department of Natural Resources and Conservation GIS software system.**

- The Sistem Informasi Industri Nasional [Indonesian National Industrial Information System] (SIINas) database collects declarations from mills, refineries and bulking facilities.
- **Sustainability certification systems** – whether government-led (ISPO) or voluntary (RSPO and ISCC) – still present a low level of uptake for smallholders, due to existing barriers to comply with scheme requirements, despite progress in numbers.[22]

In addition, farmers and dealers do not usually keep records of plantation data: dealers collect farmers' names and would normally be aware of the plantation location without needing further specific documentation. Extension officers from the Department of Plantation – whose duties include providing guidance to farmers in villages – also lack detailed data on the number of farmers, plots, and total oil palm plantation area in each village.

Palm smallholders are, therefore, mainly exposed to farm data collection through land registration, business registration, and corporate programmes:

- **Land registration**: For parcels under 25 hectares, the legal basis for land use is the Certificate of Ownership (SHM), which has been extensively granted to smallholders through the Pendaftaran Tanah Sistematis Lengkap [Complete Systematic Land Registration] (PTSL) programme. There is no publicly available data from the Ministry of Agrarian Affairs and Spatial Planning or National Land Agency (Kementerian ATR/BPN) indicating the extent of smallholder oil palm plantations that have been granted an SHM – according to interviews conducted with farmers across various regions, numerous smallholder plantations remain without SHM status (Preferred by Nature, personal communication, 2025).
- **Business registration**: Smallholders are required to register their plantation with the district-level Department of Plantation through the legal administrative form Cultivation Registration Certificate (STDB). The STDB is analogous to the plantation business permit (IUP) required for palm oil companies; the STDB is used to ascertain the status, productivity level, land ownership, technical plantation data, and various other important information. Throughout the STDB procedure, smallholders' plots undergo mapping and delineation. The e-STDB platform is the associated Integrated Plantation Business Registration System for Smallholders. It is used by field officers to enter smallholder data, plantation data, and land parcel mapping. According to information on its website, it can support temporary data collection in areas with inadequate internet access. The requirement for STDB registration includes attaching several supporting documents: a registration request letter (*surat permohonan*), a copy of the applicant's national ID card, the original land ownership letter issued by the village head, a copy of proof of land ownership (*surat hak milik* or *surat keterangan tanah*), an original letter verifying the origin of planting seeds, and a sketch map of the plantation location. Once these documents are submitted, the land will be mapped by a GIS team to verify boundaries and coordinates. The registration process typically takes up to six working days to complete. The Directorate General of Plantations (Ditjen Perkebunan) is prioritizing the STDB as the central element for smallholder data traceability. It is noteworthy that the ISPO certification requires STDB registration, and the accelerated ISPO certification for smallholders is intended to increase STDB data collection. However, despite progress in STDB registration, many smallholders still struggle to obtain STDB registration due to current land overlapping with forest designated area or other technical and financial barriers. Sustainability of Malaysian and Indonesian Palm Oil (KAMI, 2025) reports that less than 1 percent of Indonesian smallholders have received STDB and are included in the e-STDB database. One of the inhibiting factors is that the authority for STDB issuance rests with the district governments, each operating with distinct policies, priorities, and budgetary allocations, meaning uneven capacity to conduct onsite verification of smallholder plots, as well as extended, precautionary processing times since STDB is considered a legal instrument.
- **Corporate programmes**: Most smallholder data and production plot boundaries are existing where palm oil companies have undertaken data collection efforts on their own initiative. They are frequently doing so with the support of technical and support providers, such as Koltiva. Koltiva delivers digital solutions (Kolti-Trace), focusing on sustainability and transparency across agricultural supply chains. It provides an integrated software ecosystem for end-to-end data traceability, operational efficiency, and sustainability

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[22] According to 2024 RSPO data, a total of 49 943 independent smallholders and 124 864 plasma smallholders have obtained RSPO certification. Presidential Regulation No. 16 of 2025 on the ISPO Certification System is aimed at accelerating the adoption of ISPO certification, including for independent smallholders. A total of 108 smallholder groups/organizations have been granted ISPO certification. Additionally, the palm oil company PT Musim Mas has facilitated 3 294 assisted smallholders in obtaining ISPO certification.

management. Since 2017, Koltiva has accumulated hundreds of thousands of smallholder data records for developing information system traceability within the oil palm supply chain on behalf of its clients, predominantly comprising downstream industries and palm oil mills. The personal data collected includes names, national identity numbers, addresses, and information about household members. Other data collected comprises plantation polygons, land legality data, production data, environmental data, and social data. Data collection and data entry into the system are performed by field officers, not by farmers themselves (Preferred by Nature, personal communication, 2025).

In addition to government-led action and corporate action, Hamurni is another available tool and database. It has been developed by World Wide Fund for Nature (WWF) Indonesia since 2017, in response to the growing awareness of the importance of traceable palm oil (Preferred by Nature, personal communication, 2025). It records information – such as STDB registration, land legality documents, and plantation maps – using a mobile application. Farmers are expected to fill out the forms themselves, while local farmer groups act as facilitators to support data entry and guide farmers in using the application. The adoption of the app for basic data collection has not faced significant challenges. However, the use of Hamurni as a full traceability tool remains limited. Farmers often struggle to consistently record harvest yields and transactions with buyers, due to constraints like poor internet connectivity and limited digital literacy. Many smallholders, particularly those over the age of 60, are motivated to register their data in the system, but lack the skills to use the app beyond the initial data collection stage.

Finally, i-Trace[23] is a supply chain traceability application developed by PT Surveyor Indonesia and EFI through the KAMI project, funded by the European Union. Initially, this application was specifically designed for oil palm. The main features of i-Trace related to smallholder data collection and traceability include transaction recording (sales and purchases, quantities, payments, quantities, etc.) and traceability (tracing from farmers to export, including the transfer of information regarding legal and deforestation-free production). Smallholders themselves can install the application and input their personal data, such as identity card, telephone number, email, STDB, land ownership status, legal land documents, and plot geolocation data. The main display of this application features plantation geolocation, deforestation-free status, and legality.

Last but not least, a major government-led initiative, relevant to all palm oil stakeholders and data collection, is the development of the National Dashboard for Sustainable Commodity Data and Information (National Dashboard). It is still in current development, with some uncertainty of how it will exactly function, but it is primarily meant to integrate oil palm supply chain data from various systems into a single source of data, while avoiding an overly centralistic approach and allowing for public–private partnerships. The National Dashboard's function is to serve as an integrating mechanism to consolidate data inputs from multiple platforms and provide support for due diligence requirements in both domestic and international markets.

The governing regulation concerning the development of the National Dashboard is currently being drafted by the Indonesian government and is targeted for issuance in 2025. The leading ministries or institutions (the custodians) responsible for its implementation have not yet been designated. Currently, the actively involved ministries or institutions include Bappenas (National Development Planning Agency), the Ministry of Home Affairs, the Ministry of Agriculture, the Ministry of Trade, the Coordinating Ministry for Food Affairs, and the Coordinating Ministry for Economic Affairs as the initiator. KAMI recommends that existing data from the ISPO Information system, the e-STDB platform and SIPERIBUN are integrated into the National Dashboard. I-Trace and Hamurni have committed to integrating their platforms with the National Dashboard to ensure data sharing and connectivity at the national level.

6.4.2. THE STATUS QUO OF DATA GOVERNANCE

The legal framework for smallholder data governance is shaped by several regulations.

The Personal Data Protection Law (PDP Law 27 or 2022) provides the overarching legal framework to secure the rights of data subjects, including personal data contained within or linked to geoinformation (such as that of landowners). It is largely modelled on the GDPR, including rights to obtain information on the identity of the party collecting the data and the purpose of its use, to rectify and erase data, and to revoke consent. The PDP Law mandates that appropriate measures must be taken to maintain the integrity and confidentiality of personal data, which directly addresses the privacy concerns of individuals related to their location-based information.

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[23] https://efi.int/sites/default/files/files/flegtredd/KAMI/Resources/D24_i-Trace%20User%20Guidelines_EN.pdf

Also of relevance is the Geospatial Information Law (Law No. 4/2011), which introduced the One Map Policy, aiming to develop a single public source of geoinformation for all public bodies and to govern data sharing, coordination, and integration among them. The law includes administrative and criminal sanctions for violations, such as altering official base geospatial information without permission or producing and disseminating inaccurate geoinformation. This provision aims to ensure accountability for the quality of the data provided.

Thus, a general legal framework to govern smallholder data exists. However, there is uncertainty regarding how these rules should be implemented when collecting production plot information from smallholders (Fern, 2025).

Noteworthy elements of data governance across Indonesia's various palm oil data systems include:

- As per Regulation No. 14 of 2025, the ISPO Governing Body must ensure data security and confidentiality and ensure user access to the ISPO Information System through authentication and authorization systems.
- Before installing the i-Trace application, there are terms and conditions that must be agreed to.
- Farmers have access to their geolocation information with STDB registration. However, where only paper STDB has been issued by districts, geolocation information may be missing or presented in formats not aligned with EUDR requirements, and must still be shared digitally (EFI, 2025).
- The National Dashboard will not serve as the owner of the data; rather, the ownership of collected data will remain with each original data system connected to the National Dashboard.
- Hamurni has developed a consent form and conducts socialization activities prior to data collection to help farming communities understand the purpose of collecting their data.
- Koltiva has also developed a robust data collection process designed to align with the GDPR and local legislation. It involves community outreach and socialization sessions to inform farmers about the process and its purpose. Farmers are provided with written consent forms and clear explanations of which parties, such as refineries and palm oil mills, will have access to their data. Consent is collected by field agents based on a pre-written script, which can be delivered in local language (such as Bahasa). Farmers typically sign using a biometric or digital signature. Farmers have the right to withdraw from the dataset; however, this must be done via email to a dedicated address, as this was considered the most realistic, centralized approach. It was not possible to implement withdrawal through the WhatsApp messaging platform or other methods more accessible to farmers (Preferred by Nature, personal communication, 2025). The data collection form also allows farmers to provide differentiated consent: for instance, they can agree that the farm is surveyed but disagree to share their land certificate. In practice, few farmers refuse or provide differentiated consent, except for technical reasons (for example, the land certificate is not available).

In general, farmers are less aware of data security risks related to plantation mapping, though they are more familiar with risks associated with the misuse of personal ID numbers for scams or loans. The greater concerns also turn to systemic challenges, such as acquisition of quality seedlings, constrained access to subsidized fertilizer, and FFB prices falling below the Department of Plantation standard rates. These issues are compounded by inadequate extension services, training opportunities, and communication of current information concerning oil palm sector updates. These multifaceted challenges diminish smallholders' interest in programmes initiated by various entities when tangible and direct benefits are not apparent.

Although farmers lack a complete overview of the integrated palm oil supply chain information system currently being developed by the government, they strongly support the initiative. The motivation is straightforward: the farmers hope the system will facilitate their access to the standard pricing set by the Department of Plantation (Disbun). They hold high expectations that the information and traceability system will provide updated and reliable data, streamline the supply chain, facilitate fair trade, and ensure greater price transparency and stability.

6.5. SOY: BRAZIL

The soy sector in Brazil

Brazil is the largest producer and exporter of soybeans globally, representing 40 percent of the global production for a total of 169 million tonnes in 2024/25 (USDA, 2025b).

The Brazilian soy supply chain is complex and involves multiple actors across various stages. Multinational corporations – for example, Amaggi, Louis Dreyfus, Bayer, Syngenta, BASF, John Deere, Bunge and Cargill – dominate this segment, controlling seeds, fertilizers, agrochemicals, and machinery as well as export logistics and trade.

Foreign multinationals control 65.4 percent of the supply chain; Brazilian groups control 93.4 percent of the farming sector, but only 7.1 percent of the agro-industrial sectors (Medina *et al.*, 2021).

Some of the soybeans produced are processed into oil, meal, and other derivatives. Processing plants are often owned by the same multinational traders or domestic agribusinesses.

When it comes to soy farming, Brazil has a dual structure with large-scale commercial farms dominating production and exports versus small farms (properties) and small producers. A small property is defined as having fewer than four fiscal modules, and the fiscal module varies by municipality, ranging from about 5 hectares to 110 hectares. This means a small property can range from roughly 20 hectares to 440 hectares. Another concept is the small (or family) producer (*"agricultor familiar"*), whose definition includes not only having a small property, but also operating it with predominantly family labour. Small soy farms are more prevalent in certain regions but have limited market access. Over 73 percent of soybean-producing agricultural establishments in Brazil have less than 50 hectares and can be characterized as "smallholdings" according to the local legislation (Embrapa, 2024). Despite their numerical importance, those contribute only about 10 percent of total soybean production in Brazil. The majority of production comes from large farms (over 500 hectares) (Earth Innovation Institute, 2014).

Two key initiatives from the private sector have been shaping sustainable soy production in Brazil. The Soy Moratorium is a voluntary agreement established in 2006 by major soy traders, civil society organizations, and the Brazilian government. It prohibits the purchase of soy grown on land in the Amazon biome that was deforested after July 2008. Its effectiveness depends on sophisticated data governance systems, including official satellite-based forest monitoring data, land registries, and supply chain traceability. It has recently been under legal scrutiny (Reuters, 2025).

The Round Table on Responsible Soy (RTRS) is one of the main soy certification schemes. It is a global multistakeholder initiative founded in 2006 to promote the responsible production, processing, and trading of soy. It developed and implemented a certification system for responsible soy. In 2024, more than 6 million tonnes of soy were certified, covering around 2 million hectares (RTRS, 2025). Nonetheless, RTRS-certified soy represents only about 3–4 percent of Brazil's total soy production (in 2024, around 168 million tonnes were produced) (Embrapa, 2025).

EXISTING APPROACHES TO DATA COLLECTION AND MANAGEMENT

The National Supply Company (CONAB), a federal agency under the Ministry of Agriculture, Livestock and Supply (MAPA), collects and analyses soy production data, including planted area, yield, and market trends, as well as provides strategic information for policymaking and price stabilization. It does so through field surveys, remote sensing, and collaboration with state-level agricultural secretariats. It works in partnership with the Brazilian Agricultural Research Corporation (Embrapa) for technical validation and integration of agronomic data. In addition, the Brazilian Institute of Geography and Statistics (BGE) – a federal autonomous agency currently linked to the Ministry of Economy – provides official statistics and carries out the agricultural census.

The National Institute of Colonization and Agrarian Reform (INCRA) is the main federal agency responsible for the governance of rural property titles, while state agricultural and environmental secretariats also complement this role at state level.

The CAR is Brazil's official rural environmental registry. It is mandatory for all rural properties and includes georeferenced farm boundaries. Producers have online access through the Sistema Nacional de Cadastro Ambiental Rural [Rural Environmental Registration System] (SICAR) portal. They can submit corrections or updates and download registration documents. Programmes such as RetifiCAR support producers in correcting inaccurate data and navigating environmental compliance processes (CNA, 2025). The CAR is a national registry, but it is not soy-specific and lacks comprehensive integration with production data (as is the case within SeloVerde traceability systems).

In addition, much of the data is collected from producers by government agencies, industry associations (such as the Brazilian Association of Vegetable Oil Industries [Abiove]), or private initiatives (such as RTRS). Data types commonly collected include:

- production and yield data (such as harvested volumes);
- environmental and land use data (such as land conversion and legal reserve);
- sustainability and certification data (zero deforestation commitments);
- economic and trade data (sales volume, prices, etc.); and
- technological and agronomic data (seed variety, fertilizer use, etc.).

Data is collected mainly for: policymaking; trade compliance to meet international standards (such as the EUDR); sustainability tracking to monitor progress towards zero-deforestation goals; and market transparency and risk assessment to identify deforestation hotspots and supply chain vulnerabilities.

There are some efforts to standardize plot-level soy data, though it is not yet fully centralized or mandatory for all producers.

In addition, the Protocolo Verde dos Grãos do Pará [Green Protocol for Grains of Pará] is a public–private environmental governance initiative promoting transparency and traceability in the grain supply chain. It includes specific provisions around data management and confidentiality, especially regarding the environmental compliance data of producers. Companies undergo independent audits to verify compliance. Producers retain ownership of their data, particularly the information submitted to the CAR. Data is used only for compliance verification and not shared publicly unless anonymized or aggregated. The steering committee oversees data governance and ensures transparency without compromising producer privacy.

On the side of voluntary certification schemes, the Round Table on Responsible Soy (RTRS) has developed the Brazilian National Interpretation of its global standard and sets standardized criteria for certified producers, including plot-level traceability. Others initiatives such as MapBiomas and Trase initiatives provide standardized spatial datasets on soy cultivation and land use but are not official registries. Serasa Experian (formerly Agrosatélite) is the main private data provider on soy. Koltiva, through its Kolti-Trace's tool, also offers a traceability system that helps Brazil's soybean producers comply with the EUDR. It uses geolocation and historical land-use data to confirm that soy comes from deforestation-free areas. Satelligence, a service provider, similarly offers high-resolution, near real-time satellite monitoring and coverage across all relevant biomes, including the Amazon, Cerrado, and dry forest regions. Producers and cooperatives can upload plot data or may be invited to share it securely via supplier forms.

6.5.2. THE STATUS QUO OF DATA GOVERNANCE

The Brazilian General Data Protection Law (LGPD) (Law No. 13, 709/2018) has been in force since September 2020 and is modelled on the GDPR. It applies to any entity (public or private) that processes personal data in Brazil or targets Brazilian individuals. Personal data includes any information that identifies or can identify a natural person, such as name, location, financial data, or farm ownership. Key rights protected include the right to access data, the right to correct or delete inaccurate data, the right to data portability, the right to revoke consent, and the right to be informed about data usage and sharing. The National Data Protection Authority (ANPD) is the Brazilian regulator, overseeing LGPD compliance in agricultural data collection and processing, ensuring protection of personal data from producers, including smallholders.

The implementation of the LGPD in the agriculture sector, especially in the soy supply chain, remains uneven and still evolving, with notable gaps in compliance and enforcement – particularly affecting smallholders and data traceability systems (Da Silva *et al.*, 2025).

Large farms often have dedicated digital infrastructure, including precision agriculture tools, satellite monitoring, and proprietary data platforms. They are more likely to own and control their data, as well as engage directly with traceability systems. They may also negotiate data-sharing agreements with buyers or certifiers.

On the contrary, smallholders and smaller producers typically rely on government systems such as CAR for environmental registration. Data collection is often external (such as by non-governmental organizations [NGOs], cooperatives, or government agencies). Ownership and control over data is more limited, as many smallholders are not fully aware of how their data is used. Consent mechanisms are often weak or bypassed. Correction of data (such as in CAR) is possible but requires technical support, which smallholders may lack (de Beer, Oguamanam and Ubalijoro, 2022).

Digital traceability is increasingly required for exports, such as compliance with the EUDR. Smallholders express concerns about data ownership and control, vendor lock-in, misuse of commercial data and lack of transparency in how data is shared across the supply chain (World Economic Forum, 2024). Barriers include low digital literacy, limited access to training or support, and unclear consent mechanisms within platforms or certification systems.

Programmes such as the Brazilian federal government Green Seal (SeloVerde, a key initiative with an increasing number of participating states) and Agro Brasil + Sustentável Program recognize how pressures for traceability can affect smallholder farmers.

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Annex 1. Additional resources

Table A1.1 Resources offering relevant definitions and glossaries

DIASCA	Traceability, Trust and Transparency in Global Agrifood Supply Chains
USAID	Farmer-centric data governance: towards a new paradigm
IDH – Intellecap	Unlocking data sharing in agriculture
ISEAL	Unlocking the value of your data. A practical guide for sustainability systems to turn data into actionable insights. Guidance on the collection of polygon location data for sustainability systems (2025)
Committee of Professional Agricultural Organisations–General Confederation of Agricultural Cooperatives in the European Union, European Agricultural Machinery Industry Association, European Confederation of Agricultural, Rural and Forestry Contractors, European Council of Young Farmers, European Forum of Farm Animal Breeders, European Seed Association, European Feed Manufacturers' Federation, Fertilizers Europe and European Crop Protection Association	European Union Code of Conduct on Agricultural Data Sharing by Contractual Agreement
Kenya Ministry of Agriculture, Livestock, Fisheries and Cooperatives	Kenya Integrated Agriculture Management Information Systems Data Governance Framework (2024)

Table A1.2 Key resources on smallholder-centric models

USAID	Farmer-centric data governance: towards a new paradigm Associated case studies and deep dives
GFAR, GODAN, CTA	Digital and Data-Driven Agriculture: Harnessing the Power of Data for Smallholders
GIZ	Data sovereignty in agricultural value chains

Table A1.3 Resources exploring data governance in agriculture

IDH – Intellecap	Unlocking data sharing in agriculture
WRI	Traceability and Transparency in Supply Chains for Agricultural and Forest Commodities
DIASCA	Traceability, Trust and Transparency in Global Agrifood Supply Chains
FAO	Farm Data Management, Sharing and Services for Agricultural Development
ISEAL	Unlocking the value of your data: A practical guide for sustainability systems to turn data into actionable insights
Proforest	Open Data for Supply Chain Due Diligence
World Bank	The Role of Digital Identification in Agriculture: Emerging Applications
OECD	Enhancing access to and sharing of data: Reconciling risks and benefits for data re-use across societies
GFAR	Rights of farmers for data, information and knowledge
Commonwealth Secretariat	National Agricultural Data Infrastructure Policy Guide

Table A1.4 Resources establishing actionable principles or frameworks for data governance

World Bank	Principles on identification for sustainable development: Toward the digital age
FSD Fair & Smart Data	Smallholder-oriented Data Governance Principles
Committee of Professional Agricultural Organisations–General Confederation of Agricultural Cooperatives in the European Union, European Agricultural Machinery Industry Association, European Confederation of Agricultural, Rural and Forestry Contractors, European Council of Young Farmers, European Forum of Farm Animal Breeders, European Seed Association, European Feed Manufacturers' Federation, Fertilizers Europe and European Crop Protection Association	European Union Code of Conduct on Agricultural Data Sharing by Contractual Agreement
GODAN	Code of Conduct Constructor
UK FSA	United Kingdom Food Data Trust Framework
World Economic Forum	Towards a Data Economy: An Enabling Framework
ISEAL	Guidance on the collection of polygon location data for sustainability systems Webpage on collaborative data management and an ecosystem approach Webpage on Data management
OECD	Going Digital: Guide to Data Governance Policy Making
Kenya Ministry of Agriculture, Livestock, Fisheries and Cooperatives	Data Governance Framework For Farmers' Registration Data and Roadmap Towards its Operationalization (2022) Kenya Integrated Agriculture Management Information Systems Data Governance Framework (2024)
Fairfood	Who owns farmer data? Fairfood principles on data governance
Farm Data Accreditation	New-Zealand Farm Data Code of Practice: For organisations that collect, store and share primary production data

Table A1.5 Existing guidance on the collection of farm-specific data

FAO	WCA Guidelines Suite of guidelines for the Global Strategy to Improve Agricultural and Rural Statistics
World Bank	Agricultural Survey Design Guidebook
IDH / FarmFit Insight Hub	Farm Management Information System guide
ISEAL	Guidance on the collection of polygon location data for sustainability systems (2025)
Meridia / Rabo Foundation	Farm mapping guide, (2025) Field Data Quality Enhancement Toolkit (2024)
Wikifarmer Library	Best practices for Collecting Farmer Data in Agriculture
USAID	Digital Farmer Profiles: Reimagining Smallholder Agriculture

Table A1.6 Existing standards for farm data

UTZ	Reference framework for first mile farm data	Publicly available, GitHub Supported by Data Impact and Open Data Services, funded by ISEAL
Sustainable Coffee Challenge/Global Coffee Platform	Global Coffee Data Standard	Based on the reference framework for first-mile farm data
International Consortium for Agricultural System Application (ICASA)	ICASA Data Dictionary (IDD)	Designed to support the collection and sharing of data for crop modelling and agronomic research
FAO	Crop classification for agricultural census – WCA Programme (Annex 4)	Restricted to crop classification
ISEAL	ICMS – Core Metadata Set	Not specific to agriculture or smallholders; focused on certification-related information (relevant modules include: certificate module, certificate-holder module, site module)
International Organization for Standardization (ISO)	ISO 19115/19156 Geospatial metadata and observation standards	Not specific to agriculture or smallholders
GS1	GLN (Global Location Number) Standard	Not specific to agriculture or smallholders
Open Geospatial Consortium (OGC)	Suite of Standards for geospatial data and services	Widely used in the agricultural sector
farmOS	farmOS Data model	Free, open-source application that's web-based for farm management, planning and record keeping

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